Project Manual

for

NEW WASTEWATER TREATMENT PLANT LAB OFFICE BUILDING
Bid No.: 2018-80
PBK Project No.: 1811

for the

THE CITY OF Edinburg

22 June 2018

Issued for 100% Construction Documents

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City Council

Richard Molina	Mayor
David Torres	Mayor Pro-Tem
Gilbert Enriquez	Council Member
Homer Jasso Jr.	Council Member
Jorge Salinas	Council Member

Administration

Pilar Rodriguez	City Manager
Sonia Marroquin	Assistant City Manager
Ponciano Longoria	Director of Public Works
Arturo Martinez	Utilities Director

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Consultants

Architect
PBK Architects, Inc.
3900 North 10th Street, Suite 810
McAllen, Texas 78501
Phone: (956) 687-1330

Structural
Chanin Engineering
400 Nolana, Suite H2
McAllen, Texas 78504
Phone: (956) 687-9421

Civil
Melden & Hunt, Inc.
115 W. McIntyre
Edinburg, Texas 78541
Phone: (956) 381-0981

MEPT
Sigma HN Engineers
701 S. 15th Street
McAllen, Texas 78501
Phone: (956) 332-3206

REGISTERED ARCHITECT BRAD ALLAN BERGER STATE OF TEXAS 21671

STATE OF TEXAS MIGUEL CHANIN 93127 LICENSED PROFESSIONAL ENGINEER

6-22-18

STATE OF TEXAS MARIO A. REYNA 117368 LICENSED PROFESSIONAL ENGINEER

6-22-18

06.22.18

STATE OF TEXAS J. GABRIEL HINOJOSA 96585 LICENSED PROFESSIONAL ENGINEER

06·22·2018

STATE OF TEXAS JOSE ANTONIO NICANOR 108783 LICENSED PROFESSIONAL ENGINEER

06·22·2018

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NOTICE TO BIDDERS

The City of Edinburg is soliciting sealed bids to be received by the City Secretary's Office located at 415 W. University Drive, Edinburg, Texas 78541. City of Edinburg normal business days are Monday through Friday between the hours of 8:00 a.m. to 5:00 p.m. and shall be closed on recognized holidays.

Bids will be received until **3:00 p.m. Central Time**, on **Monday, July 23, 2018**, shortly thereafter all submitted bids will be gathered and taken to the Edinburg City Hall Community Room, 1st Floor, to be publicly opened and read aloud. Any bid received after the closing time will not be accepted and will be returned to the bidder unopened. It is the responsibility of the bidder to see that any bid submitted shall have sufficient time to be received by the City Secretary's Office prior to the bid opening date and time. The receiving time in the City Secretary's Office will be the governing time for acceptability of the bids. Bids will not be accepted by telephone or facsimile machine. All bids must bear original signatures and figures. The Bid shall be for:

BID NO. 2018-80
NEW WASTEWATER TREATMENT PLANT LAB OFFICE BUILDING

If you have any questions or require additional information regarding this bid, please contact LORENA FUENTES, PURCHASING AGENT, LOCATED AT 415 W. UNIVERSITY DRIVE, Edinburg, TX 78541 by calling (956) 388-1895 or via e-mail at: lfuentes@cityofedinburg.com

Qualified Offerors (General Contractors) may obtain a set of plans, proposal forms, specifications, and contract at the location indicated upon a deposit of **$100.00** per set with check made payable to **PBK Architects, Inc**. The deposit will be refunded when the documents are returned in good condition within ten (10) days from the bid date.

Proposal Documents may be obtained from:

RGV Reprographics
519 S Broadway
McAllen, Texas 78501
(956) 686-1525

Copies of the plans and specifications may be *examined without charge* at the following location:

City of Edinburg, City Hall 2nd Floor, Utilities
415 W. University Drive
Edinburg, Texas 78541

If Hand-delivering Bids: 415 West University Drive,
c/o City Secretary Department (1st Floor)

If using Land Courier (i.e., FedEx, UPS): City of Edinburg
c/o City Secretary
415 West University Drive
Edinburg, Texas 78541

If Mailing Bids: City of Edinburg
c/o City Secretary
P.O. Box 1079
Edinburg, TX 78540-1079

The City of Edinburg reserves the right to refuse and reject any or all bids and to waive any or all formalities or technicalities and to accept the bid deemed most advantageous to the City, and hold the bids for a period of **60** days without taking action.

Bids must be submitted in an envelope sealed with tape and prominently marked on the lower left hand corner of the bid envelope with corresponding bid number and title.

CITY OF EDINBURG
INSTRUCTIONS TO BIDDERS

DEVIATION FROM SPECIFICATION

Please read your specifications/requirements thoroughly and be sure that the SERVICES offered comply with all specifications/requirements. Any variation from the specifications/requirements must be clearly indicated by letter attached to your bid referencing variations on a point-by-point basis. If no exceptions are noted, and you are the successful bidder, it will be required that the SERVICES be provided as specified.

PURPOSE

1. The purpose of these specifications/requirements and bidding documents is for the purchase of **NEW WASTEWATER TREATMENT PLANT LAB OFFICE BUILDING** for the City of Edinburg at firm unit prices, for various contract term dates (**If applicable**).

2. The SERVICES to be furnished under this bid shall be as specified in these bid documents. All specifications/requirements shown are minimum. There is no intention to disqualify any bidder who can meet these specifications/requirements.

SUBMITTAL OF BID

Bids will be submitted in sealed envelopes upon the blank bid form attached hereto. Submit two (2) complete sets of the bid, one (1) original marked "**ORIGINAL,"** and one (1) copy marked "**COPY**". Each bid must be completely filled out and **SUBMITTED IN ORIGINAL FORM**, complete with all supporting documentation. Bids submitted by facsimile (fax) or electronically will **NOT** be accepted. Submittal of a bid in response to this solicitation for Bids constitutes an offer by the Bidder. Bids which do not comply with these specifications/requirements may be rejected at the option of the City. Bids must be filed with the City of Edinburg, before opening day and hour. No late Bids will be accepted. They will be returned to Bidder unopened (if properly identified).

If Hand-delivering Bids:	415 West University Drive, c/o City Secretary Department (1st Floor)
If using Land Courier (i.e., FedEx, UPS):	415 West University Drive, c/o City Secretary Department (1st Floor), Edinburg, Texas 78541
If Mailing Bids:	P.O. Box 1079, Edinburg, TX 78540-1079

PREBID

A pre-bid conference will be held at 3:00 p.m., Monday, July 16, 2018 at the Edinburg City Hall Community Room, 1st Floor, located at 415 W. University Drive, Edinburg, Texas. All prospective bidders are encouraged to attend. If you have any questions or require additional information regarding this bid, please contact PBK Architects, Inc.
(956)687-1330.

PREPARATION OF BID

Bids MUST give full firm name and address of bidder, and be manually signed. Failure to do so will disqualify your bid. Person signing bid must show title or AUTHORITY TO BIND HIS/HER FIRM IN A CONTRACT.

Firm name and authorized signature must appear on each page that calls for this information. The legal status of the Respondent/Bidder whether corporation, partnership, or individual, shall also be stated in the bid. A corporation shall execute the bid by its duly authorized officers in accordance with its corporate by-laws and shall also list the state in which it is incorporated. A partnership Respondent/Bidder shall give full names and addresses of all partners. All partners shall execute the bid. Partnership and Individual Respondent/Bidder shall state in the bid the names and addresses of all persons with a vested interest therein. The place of residence of each Respondent/Bidder, or the office address in the case of a firm or company, with county and state and telephone number, shall be given after the signature.

INSTRUCTIONS TO BIDDERS (Continued):

ALTERATIONS/AMENDMENTS TO BID
Bids **CANNOT** be altered or amended after opening time. Alterations made before opening time must be initialed by bidder guaranteeing authenticity. No bid may be withdrawn after opening time without acceptable reason in writing and only after approval by the City of Edinburg.

SALES TAX
State sales tax must not be included in the bid.

SUBSTITUTIONS
No substitutions or cancellations will be permitted without written approval of City of Edinburg.

NO BID RESPONSE
If unable to submit a bid, bidder should return inquiry giving reasons.

EXCEPTIONS
Any additions, deletions, or variations from the following specifications/requirements must be noted. The bidder shall attach to his/her bid sheet a list of any exceptions to the specifications/requirements if unable to do so, on specification sheet.

BRAND OR MANUFACTURER REFERENCE
Unless otherwise specified, any catalog or manufacturer's reference or brand name used in describing an item is merely descriptive, and not restrictive, and is used only to indicate type and style of product desired. Bids on alternate brands will be considered if they meet specification requirements. If a bidder quotes on equipment other than the one(s) specified in the bid, sufficient specifications and descriptive (pictured literature) data must accompany same to permit thorough evaluation. In the absence of these qualifications, he/she will be expected to furnish the product called for.

DELIVERY
Number of days required to deliver SERVICES after receiving order must be stated in the bid. Failure to so state will obligate bidder to complete service delivery within ONE day.

DELAY IN SERVICE DELIVERY
When delay can be foreseen, Bidder shall give prior notice to City of Edinburg. Bidder must keep City of Edinburg advised at all times of status of order. Default in promised service delivery (without acceptable reasons) or failure to meet specifications/requirements, authorizes the City of Edinburg to purchase such SERVICES elsewhere and charge increase in cost to defaulting vendor. Acceptable reasons for delayed delivery are as follows: Acts of God (floods, tornadoes, hurricanes, etc.), acts of government, fire, strikes, war; Actions beyond the control of the successful bidder.

SERVICE DELIVERED PRICING
Bids in units of quantity specified - extend and show total. In the event of discrepancies in extension, unit prices will govern. Bids subject to unlimited price increase will not be considered.

VALID BID TIME FRAME
The City may hold bids 60 days after bid opening without taking action. BIDDERS shall be required to hold their Bids firm for the same period of time.

INSTRUCTIONS TO BIDDERS (Continued):

RIGHT TO REJECT/AWARD

The City of Edinburg reserves the right to refuse and reject any or all Bids, and to waive any or all formalities or technicalities, and to make such awards of contract as may be deemed to be the best and most advantageous to the City of Edinburg.

MULTIPLE VENDOR CONTRACTS

Bidders are advised that the City of Edinburg may award Service Contracts to multiple vendors based on low bid per item basis. All items specified on the "Bid Form" **must** reflect the individual unit prices. The City of Edinburg reserves the right to award all items individually or in any combination thereof. The City reserves the right to award each item separately or individually, award to one or multiple vendors, and accept the proposal deemed most advantageous to the City.

INDEMNIFICATION CLAUSE

The Bidder agrees to indemnify and save harmless the City, from all suits and actions of every nature and description brought against them or any of them, for or on account of the use of patented appliances, products or processes, and he shall pay all royalties and charges which are legal and equitable. Evidence of such payment or satisfaction shall be submitted upon request of the Purchasing Agent, as a necessary requirement in connection with the final estimate for payment in which such patented appliance, products or processes are used.

ADDENDA

Bidder shall carefully examine the bid forms, specifications/requirements, and instructions to Bidders. Should the bidder find discrepancies in, or omissions from bid forms, specifications/requirements, or other documents, or should he/she be in doubt as to their meaning, he/she should at once notify the Purchasing Agent at 956-388-1895 and obtain clarification by addendum prior to submitting any bid. Explanations, interpretations, and supplemental instructions shall be in the form of written Addenda which shall become a part of the Contract documents. Said Addenda shall be mailed, e-mailed, hand delivered and/or faxed, to all prospective Bidders. All Addenda issued in respect to this project shall be considered official changes to the original bid documents. Verbal statements in response to inquiries and/or requests for explanations shall not be authoritative nor binding. It shall be the Bidder(s) responsibility to ensure that they have received all Addenda in respect to this project. Furthermore, Bidders are advised that they must recognize, comply with, and attach a signed copy of each Addendum which shall be made part of their Bid Submittal. Bidder(s) signature on Addenda shall be interpreted as the bidder's "recognition and compliance to" official changes as outlined by the City of Edinburg and as such are made part of the original solicitation documents. Failure of any bidder to receive any such addendum or interpretation shall not relieve such Bidder from its terms and requirements. The City may issue a written addendum no later than five calendar days prior to the date bids must be received. Addendums are available online at www.cityofedinburg.com.

PAYMENT

The City of Edinburg will execute payment by mail in accordance with the State of Texas Pay Law after SERVICES have been provided and invoiced. No other method of payment will be considered.

SYNONYM

Where in this bid package ITEMS OR SERVICES is used its meaning shall refer to the purchase of NEW WASTEWATER TREATMENT PLANT LAB OFFICE as specified.

ASSIGNMENT

Neither the Bidder's contract nor payment due to an awarded vendor may be assigned to a third party without the

written approval of the Purchasing Department for the City of Edinburg.

INSTRUCTIONS TO BIDDERS (Continued):

INTERPRETATIONS

Any questions concerning the conditions and/or specifications/requirements with regards to this solicitation for Bids shall be directed to the designated individuals as outlined in the Request for Bids. Such interpretations, which may affect the eventual outcome of this request for Bids, shall be furnished in writing to all prospective Bidders via

Addendum. No interpretation shall be considered binding unless provided in writing by the City of Edinburg in accordance with paragraph entitled "Addenda".

STATUTORY REQUIREMENTS

It shall be the responsibility of the successful Bidder to comply with all applicable State & Federal laws, Executive Orders and Municipal Ordinances, and the Rules and Regulations of all authorities having jurisdiction over the work to be performed hereunder and such shall apply to the contract throughout, and that they will be deemed to be included in the contract as though written out in full in the contract documents. (To include issues related to health, environmental, and safety to name a few.)

BIDDER'S EMPLOYEES

Neither the Bidder nor his/her employees engaged in fulfilling the terms and conditions of this Purchase Contract shall be considered employees of the City. The method and manner of performance of such undertakings shall be under the exclusive control of the vendor on contract. The City shall have the right of inspection of said undertakings at any time.

RIGHT TO WAIVE

City of Edinburg reserves the right to waive or take exception to any part of these specifications/requirements when in the best interest of the City of Edinburg.

COOPERATIVE PRICING

Bidders are advised that in addition to responding to our "local" solicitation for bids/Bids with Dealer pricing, vendors/contractors are encouraged to provide pricing on the below referenced items/products/services based on BuyBoard, TX-MAS, H-GAC and/or any other State of Texas recognized and approved cooperative which has complied with the bidding requirements for the State of Texas. If bidding other than or in addition to "dealer" pricing, kindly duplicate the bid forms for each bid being provided from a cooperative contract. Any and all applicable fees must be included. All cooperative pricing must be submitted on or before bid opening date and hour.

TIME ALLOWED FOR ACTION TAKEN

The City of Edinburg may hold bids **60** days after the opening of Bids without taking action. Bidders are required to hold their Bids firm for same period of time.

PREPARATION OF BID

The City of Edinburg shall not be held liable for any costs incurred by any bidder for work performed in the preparation of and production of a bid or for any work performed prior to execution of contract.

CONFIDENTIAL INFORMATION

Any information deemed to be confidential by the bidder should be clearly noted on the pages where confidential

information is contained; however, the City cannot guarantee that it will not be compelled to disclose all or part of any public record under Texas Public Information Act, since information deemed to be confidential by the bidder may not be considered confidential under Texas Law, or pursuant to a Court order.

INSTRUCTIONS TO BIDDERS (Continued):

VERBAL THREATS

Any threats made to any employee of the City, be it verbal or written, to discontinue the providing of item/material/services for whatever reason and/or reasons shall be considered a breach of contract and the City will immediately sever the contract with the Vendor on contract.

MATHEMATICAL ERRORS

In the event that mathematical errors exist in any bid, unit prices/rates -v- totals, unit prices/rates will govern.

AUDIT

The City of Edinburg reserves the right to audit the vendor's books and records relating to the performance of this contract. The City of Edinburg, at its own expense, shall have the right at all reasonable times during normal business hours and upon at least twenty-four (24) hours' advance notice, to audit, to examine, and to make copies of or extracts from the books of account and records maintained by the vendor(s) with respect to the Supply/Service and/or Purchase Contract. If such audit shall disclose overpayment by City to vendor, written notice of such overpayment shall be provided to the vendor and the amount of overpayment shall be promptly reimbursed by vendor to the City. In the event any such overpayment is not paid within ten (10) business days after receipt of such notice, the unpaid amount of such overpayment shall bear interest at the rate of one percent (1%) per month from the date of such notice until paid.

PAST PERFORMANCE

Vendor's past performance shall be taken into consideration in the evaluation and award of Service Contract for the Purchase of SERVICES.

JURISDICTION

Contract(s) executed as part of this solicitation shall be subject to and governed under the laws of the State of Texas. Any and all obligations and payments are due and performable and payable in Hidalgo County, Texas.

VENUE

The parties agree that venue for purposes of any and all lawsuits, cause of action, arbitration, and/or any other dispute(s) shall be in Hidalgo County, Texas.

IF YOU HAVE ANY QUESTIONS ABOUT COMPLIANCE, PLEASE CONSULT YOUR OWN LEGAL COUNSEL. COMPLIANCE IS THE INDIVIDUAL RESPONSIBILITY OF EACH PERSON OR AGENT OF A PERSON WHO IS SUBJECT TO THE FILING REQUIREMENT. AN OFFENSE UNDER CHAPTER 176 IS A CLASS "C" MISDEMEANOR.

CONFLICT OF INTEREST

CHAPTER 176 OF THE TEXAS LOCAL GOVERNMENT CODE

Effective January 1, 2006, Chapter 176 of the Texas Local Government Code requires that any vendor or person considering doing business with a local government entity disclose in the Questionnaire Form CIQ, the vendor or person's affiliation or business relationship that might cause a conflict of interest with a local government entity. By law, this questionnaire must be filed with the records administrator of the City of Edinburg not later than the 7th business day after the date the person becomes aware of facts that require the statement be filed. See Section

176.006, Local Government Code. A person commits an offense if the person violates Section 176.006, Local Government Code. An offense under this section is a Class C misdemeanor. For more information or to obtain Questionnaire CIQ go to the Texas Ethics Commission web page at www.ethics.state.tx.us/forms/CIQ.pdf.

INSTRUCTIONS TO BIDDERS (Continued):

CERTIFICATE OF INTERESTED PARTIES (Form 1295)

In 2015, the Texas Legislature adopted House Bill 1295, which added section 2252.908 of the Government Code. The law states that a governmental entity or state agency may not enter into certain contracts with a business entity unless the business entity submits a disclosure of interested parties to the governmental entity or state agency at the time the business entity submits the signed contract to the governmental entity or state agency. The law applies only

to a contract of a governmental entity or state agency that either (1) requires an action or vote by the governing body of the entity or agency before the contract may be signed or (2) has a value of at least $1 million. The disclosure requirement applies to a contract entered into on or after January 1, 2016. For more information go to the Texas Ethics Commissionweb page at www.ethics.state.tx.us/forms/CIQ.pdf.

AWARD

For purposes of this project, award will be contingent on approval of budget.

CONSIDERATION OF LOCATION OF BIDDER'S PRINCIPAL PLACE OF BUSINESS

The City may give local vendors, whose principal place of business is located within the City of Edinburg, and whose bid is within five percent (5%) of the lowest bid price preference as allowed by Section 271.9051 of the Local Government Code

SPECIAL CIRCUMSTANCES

In the event that the City of Edinburg has an immediate need for a particular service(s) that is/are on contract and the

successful vendor on contract is not able to meet the special service delivery needs of the City of Edinburg, the City of Edinburg reserves the right to purchase such services elsewhere to fulfill its' immediate need.

TERMINATION OF CONTRACT

The City of Edinburg reserves the right to terminate the contract if, in the opinion of the City of Edinburg, the successful vendor's performance is not acceptable, if the City is being repeatedly over charged, improperly charged, no funds are available, or if the City wishes, without cause, to discontinue this contract. Termination will be in written form allowing a 30-day notice. The bidder shall be afforded the same right to terminate this contract in the same manner.

INSTRUCTIONS TO BIDDERS (Continued):

STANDARD INSURANCE REQUIREMENTS

Staff may waive insurance requirements for contracts $0 - $4,999.99, including but not limited to contracts for food, materials, supplies, and construction. Workers' Compensation in amounts which satisfy statutory coverage shall be required for construction projects.

The following insurance requirements will be included in all City contracts of $5,000 - $14,999.99. In contracts not involving building and construction projects, as that activity is defined in TEX. LABOR CODE §406.096, contractors may obtain alternative form of worker accident insurance with minimum limits of liability of $100,000 per claim.

Minimum Insurance Requirements	
Type of Coverage	**Limits of Liability**
Worker's Compensation	Statutory Coverage
Comprehensive General Liability (City named as additional insured) Bodily Injury	$250,000 each person/$500,000 each occurrence
Property Damage	$100,000 each occurrence/$100,000 aggregate or $500,000 combined single limits

The following insurance requirements will be included in all City contracts of $15,000 or more.

INSTRUCTIONS TO BIDDERS (Continued):

(1) The successful bidder will be required to carry the following insurance coverage and limits of coverage, as well as list the City as an additional insured to liability coverage as requested by the City. In addition, the successful bidder shall provide the City with evidence of coverage and furnish acceptable proof of payment of insurance premiums.

(2) The successful bidder will be required to secure and/or have insurance coverage in force with an admitted property and casualty insurance company licensed by the State of Texas to conduct business in the State of Texas.

(3) In contracts not involving building and construction projects, as that activity is defined in TEX. LABOR CODE §406.096, contractors may obtain alternative form of worker accident insurance with minimum limits of liability of $100,000 per claim.

Minimum Insurance Requirements	
Type of Coverage	**Limits of Liability**
Worker's Compensation	Statutory Coverage
Employer's Liability	Bodily Injury by Accident: $100,000 each accident Bodily Injury by Disease: $100,000 each employee/$500,000 policy limit
Comprehensive General Liability Bodily Injury Property Damage	 $250,000 each person/$500,000 each occurrence $100,000 each occurrence/$100,000 aggregate or $500,000 combined single limits
Comprehensive Auto Liability Bodily Injury Property Damage	 $100,000 each person/$500,000 each occurrence $100,000 each occurrence/$100,000 aggregate or $500,000 combined single limits
City's Protective Liability Bodily Injury Property Damage	 $250,000 each person/$500,000 each occurrence $100,000 each occurrence/$100,000 aggregate or $500,000 combined single limits

Policies must name the City of Edinburg as an Additional Insured.
Certificates of insurance naming the CITY as an additional insured shall be submitted to the CITY for approval

prior to any services being performed by Contractor. Each policy of insurance required hereunder shall extend for a period equivalent to, or longer than the term of the Contract, and any insurer hereunder shall be required to give at least thirty (30) days written notice to the CITY prior to the cancellation of any such coverage on the termination date, or otherwise. This Contract shall be automatically suspended upon the cancellation, or other termination, of any required policy of insurance hereunder, and such suspension shall continue until evidence that adequate replacement coverage is provided to the CITY. If replacement coverage is not provided within thirty (30) days following suspension of the Contract, the Contract shall automatically terminate.

INSTRUCTIONS TO BIDDERS (Continued):

BID BOND REQUIREMENTS – *CONSTRUCTION PROJECTS ONLY*

If the contract amount is over twenty-five-thousand dollars ($25,000) for construction of the project, the successful bidder shall provide a bid guarantee, give a good and sufficient bond in the full amount of the contract price for the faithful performance of such contract, executed by a surety company authorized to do business in the State of Texas, in accordance with Article 5160, Vernon's Texas Civil Statutes, and amendments thereto. A payment bond in the full amount of the contract price to assure payment shall be required by law of all persons supplying labor and material in the execution of the project provided for in the contract documents.

A bid guarantee equivalent to five percent (5%) of the bid price will be required from each bidder. The "bid guarantee" shall consist of a firm commitment, such as a bid bond, certified check or other negotiable instrument accompanying a
bid as assurance that the bidder will upon acceptance of his/her bid, execute such contractual documents as may be required within the time specified.

A performance bond on the part of the contractor for one-hundred percent (100%) of the contract price will be required. A "performance bond" is one executed in connection with a contract to secure fulfillment of all the contractor's obligations under such contract.

A payment bond on the part of the contractor for one-hundred percent (100%) of the contract price will be required. A "payment bond" is one executed in connection with a contract to assure payment, as required by law, of all persons supplying labor and material in execution of the work provided for in the contract documents.

Bidders are expressly advised to review the contract documents fully and insurance requirements of the proposed contract as to their legal requirements and the causes which may lead to the disqualification of a bidder and/or rejection of a bid proposal. No bid may be withdrawn within a period of sixty (60) days after the dated fixed for opening the bids. Unless all bids are rejected, the Owner will give Notice of Award of Contract to the successful bidder as soon as possible consistent with the time for a thorough analysis of bids submitted. Bidders are expected to inspect the site of work and to inform themselves regarding all local conditions which may affect their bid.

DOCUMENT 00 20 00 - INSTRUCTIONS TO OFFERORS

1.1 QUALIFIED OFFERORS

A. Competitive Sealed Proposals will be accepted from qualified Offerors (General Contractors) only for the entire scope of work described in the Contract Documents. As a prerequisite to an Offeror's qualifying for the award of contract on this work, the Offeror must complete each item of Document 00 45 00 Selection Criteria and Contractor Information Sheet. In addition to the information contained in Document 00 45 00, Offerors shall address the selection criteria issues specified for Determination of Successful Respondent and Award of Contract. Submit the Statement and other requested information with the Proposals in duplicate to be retained by the Owner. Qualification statements submitted by facsimile transmission will not be accepted.

B. The primary purposes of the evaluation process will be to:
   1. Gather information for the Owner's evaluation procedure.
   2. Enable the Owner and/or Architect to evaluate the Offeror's qualifications.

C. After review of Proposals and Contractor’s qualifications evaluation the Owner will make its decision and each Offeror will be notified.

D. In arriving at its opinion concerning the Offeror's qualifications, the Architect will use the same criteria that the Owner will use in determination of the successful Offeror as specified.

E. In the event a proposed Offeror fails to submit the specified Contractor's Qualification Statement at time of receipt for Proposals, noncompliance shall be considered by the Owner and Architect as a negative factor in the determination of the successful Offeror.

1.2 OFFEROR’S PRESENTATION

A. In making its Proposal, the Offeror represents that the Offeror:
   1. Has read and understands the Propose Documents and the Proposal is made in accordance with the drawings and specifications.
   2. Has thoroughly familiarized itself with Division 1 General Requirements as applicable to subsequent specification sections.
   3. Has visited the site, familiarized itself with local conditions under which the work will be performed and has correlated observations with the requirements of the proposed Contract Documents.
   4. Agrees to comply with requirements. An Offeror who subsequently does not agree to comply with the requirements will automatically disqualify itself from proposing or receiving award of the contract.

B. If the proposal is accepted, the Offeror agrees that:
   1. Work on the project will begin immediately upon receipt of signed Contract or Notice to Proceed.
   2. It will participate as a team member in cooperation with the Project Architect, Engineers, Owner, and Owners agents and/or consultants.
   3. It will assign a competent full time superintendent, to the project, and that superintendent shall remain on the project for the duration of the project, subject only to continuous employment.
   4. It provide a proposal bond in the amount of five percent (5%) of the contract amount.
   5. If awarded, it shall furnish and pay for a Performance Bond and a Payment Bond each in the full contract amount.

6. It shall carry and keep in full force for the duration of the Project, insurance coverage for Builder's Risk, Workmen's Compensation, Comprehensive General Liability, and Automobile Liability required by the A201 General Conditions and the Agreement.
7. By making its Proposal represents that the Proposal includes material and equipment specified in the Proposal Documents and supplemented, if necessary, for a complete and operating system.
8. Where subcontract work is involved and where Acceptable Subcontractors are designated for particular portions or phases of the Work, by making the Proposal, the Contractor represents that its Proposal includes only firms designated as Acceptable Subcontractors.
9. That no asbestos PCBs or lead building materials shall be used, and that the Offeror and subofferors and suppliers submitting a proposal to a Offeror, shall submit an affidavit at Project Close Out stating that no asbestos, PCB, or lead building materials has been used on the Project.

1.3 PROPOSAL DOCUMENTS

A. Proposal Documents include the Request for Competitive Bids, Instructions to Offerors, the Proposal Form, and the proposed Contract Documents, including Addenda issued prior to receipt of proposals.

B. Contract Documents for the work consist of the AIA A101 Owner-Contractor Agreement as modified by the Owner, the AIA Document A201General Conditions modified by the Owner, the Drawings, the Specifications, and Addenda issued prior to receipt of proposals. Should there be a conflict between the terms of the proposal and the terms of the AIA A101 and AIA A201, as amended by the Owner, the terms of the AIA A101 and AIA A201 control.

1.4 PROPOSAL PROCEDURES

A. A proposal is invalid if it has not been received at the designated location prior to the time and date for receipt of proposals indicated in the Request for Competitive Sealed Proposals, or prior to any extension thereof issued to the Offerors by Addenda.

B. Requested Alternates shall be proposed. If no change in the Base Proposal is required, enter "No Change".

C. Prior to the receipt of Proposals, Addenda will be forwarded by the Architect and will be available for inspection wherever the proposal documents are kept available for that purpose.

D. Proposals will be received in duplicate only on the Owner's Form of Proposal for the work as indicated by the Proposal Documents, filled in, and enclosed in a sealed envelope prominently marked on the lower left hand corner of the bid envelop as follows:

Name of Offeror (General Contractor)
New Wasterwater Treatment Plant Lab Office Building (Bid No. 2018-80)
Attn: Lorena Fuentes, Purchasing Agent

E. The Proposal shall be accompanied by Proposal Bond or Certified Check in the amount of 5% of the proposal.

F. Deliver proposals in duplicate, one (1) original marked “ORIGINAL” and one (1) marked “COPY” in a sealed envelope to the location specified at or before the established time and date. Proposal submitted using the U.S. Postal System shall be sent as Registered Mail.

G. A proposal may be withdrawn upon request by the Offeror or its duly authorized representative, provided the request is received by the Owner at the location designated for receipt of

proposals and prior to the time fixed for the opening of proposals. A withdrawal of a proposal shall not be effective unless a written confirmation of the withdrawal is received by the Owner at the location of the bid opening within 48 hours before the time established for the opening of proposals. The Proposal Bond will be returned with the proposal is withdrawn in accordance with specified procedures. The withdrawal of a proposal does not prejudice the right of the Offeror to file a new proposal at the time and place stated. No proposal may be withdrawn for 30 days after the time fixed for the opening of proposals.

1.5 INTERPRETATION OF PROPOSAL DOCUMENTS

A. Offerors and subofferors requiring clarification or interpretation of the Proposal Documents shall make a written or verbal request which shall reach the Architect at least ten days prior to the date for receipt of proposals.

B. Interpretation, correction, or change of the Proposal Documents will be made by Addendum. Interpretations, corrections, or changes of the Proposal Documents made in any other manner are not binding.

1.6 SUBSTITUTIONS OF MATERIALS AND EQUIPMENT

A. The materials, products and equipment described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an addendum as a substitution prior to the submission of proposals.

B. Substitutions will not be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least seven days prior to the date established for receipt of proposals and the substitution request complies with requirements of Section 012500. The proposer shall complete the Substitution Request Form and submit with complete supporting data including drawings, catalogue cuts, performance and test data and other technical data necessary for an evaluation. The Architect's decision of a proposed substitution shall be final.

C. If the Architect accepts a proposed substitution prior to receipt of proposals, notice of acceptance shall be by Addenda.

D. No substitutions will be considered after the Contract award.

1.7 REJECTION OF PROPOSALS

A. The Owner reserves the right to reject any or all proposals and to reject a proposal that is not accompanied by the required proposal security or other data required by the Proposal Documents, and to reject a proposal which the Owner considers incomplete or irregular.

B. The Owner reserves the right to reject any or all proposals and to waive any formalities or irregularities and to make the award of the contract in the best interest of the Owner.

C. The Owner reserves the right to reject a proposal if the evidence submitted by, or investigation of, the offeror fails to satisfy the Owner that the offeror is properly qualified to carry out the obligations of the contract and to complete the work. Award of the Contract may be made to other than the low dollar offeror and may be awarded to the Offeror proposing the best value to the Owner, in addition to the purchase price, based on the Contractor information provided

according to the information requested in documents 00 45 00 Selection Criteria and Contractor Information Sheet.

D. Do not submit voluntary alternates. The Owner reserves the right to reject proposals accompanied by conditional or qualifying statements, or voluntary alternates.

1.8 INSURANCE

A. Each Offeror shall include in its proposal the cost of insurance and shall carry and keep insurance in full force for the duration of the project. Provide insurance coverage required under the AIA Document A201 General Conditions modified by the Owner and included herein as Instructions to Bidders.

1.9 PERFORMANCE BOND AND PAYMENT BOND

A. Each Offeror shall include in its proposal the cost for the premium for 100% Performance Bond and 100% Payment Bond. The bonds shall cover the faithful performance of the contract and payment of obligations arising thereunder in such form as the Owner may prescribe. The bonding companies must be acceptable to the Owner. The selected Offeror shall deliver the required bonds to the Owner no later than the date of execution of the Contract.

1.10 PROPOSAL SECURITY

A. No proposal will be considered unless it is accompanied by a Certified or Cashier's Check or Proposal Bond executed on the form attached. In either case the amount shall be not less than five (5%) percent of the greatest amount proposed (considering alternates, if any). The proposal security shall insure the execution of the contract and the furnishing of an acceptable Performance Bond and Payment Bond by the successful Offeror within ten days after notification of award to Offeror and that its proposal shall not be withdrawn for a period of 30 days after date of opening of proposals without the consent of the Owner. Proposal Bond shall be prepared in the identical form of AIA Document A310.

1.11 SUBMISSION OF POST PROPOSAL INFORMATION

A. The apparent Selected Offeror shall within three days after proposals are received submit the following:
   1. A statement of costs for each major item of work included in the proposal described in Section 012900. Each portion of work identified in the specifications shall be considered a major item of work and shall be shown as a separate cost item.

1.12 AWARD OF CONTRACT

A. The Selected Offeror will be notified within 60 days from the date on which proposals are opened. Offerors shall hold their offer open for 60 days after the submission deadline. If the Owner is unable to negotiate a contract with the first selected offeror, the Owner shall formerly end negotiations with that offeror and proceed to the next offeror in the order of the competitive bids evaluated until a contract is reached or each proposal is rejected.

B. The Offeror will be required to (a) submit its Proposal and Proposal Bond, (b) execute Contract and Performance and Payment Bonds, and (c) submit Certificates of required insurances, using the Owner's respective forms.

C. Proposal Bond is forfeited if proposal is withdrawn after the proposal opening, or Contract Documents are not executed in accordance with specified procedures or time period.

1.13 NOTICE TO PROCEED

A. The Offeror shall not commence work under this Contract until it receives a written Notice to Proceed or the Contract is duly signed by the Owner.

1.14 COMPLETION TIME

A. Offerors shall familiarize themselves with the Owners requirements concerning the project schedule. The project is to be substantially complete no later than January 31, 2019.

B. Having thoroughly familiarized itself with the conditions as they exist at the building site and acquainted itself with the labor supply and the material market, the Offeror shall state in its proposal that it agrees to be substantially complete with the work within the calendar days stated in its Proposal.

C. The definition of Substantial Completion is found in Article 9.8.1 of the AIA Document A201 General Conditions of the Contract for Construction modified by the Owner.

1.15 AFFIDAVIT OF NONDISCRIMINATORY EMPLOYMENT

A. The Offeror and subofferors agree to refrain from discrimination in terms and conditions of employment to the basis of race, color, religion, sex, or national origin, and agrees to take affirmative action as required by Federal Statutes and Rules and Regulations issued in order to maintain and insure non-discriminatory employment practices.

B. The Offerors shall execute Document 00 40 13 Affidavit of Nondiscriminatory Employment and submit with Proposal. Subofferors shall execute Document 00 40 13 Affidavit of Nondiscriminatory Employment prior to commencing work on the Project. Offerors and subofferors who do not execute Document 00 40 13 are not be eligible to work on the project.

1.16 SUBCONTRACTOR LISTING

A. The Offeror shall supply a listing of the primary subcontractors using Document 00 40 12:
   1. Mechanical.
   2. Electrical.
   3. Plumbing.
   4. Concrete
   5. Masonry.
   6. Steel.
   7. Roofing.
   8. Any other prudent subcontractor.

1.17 AFFIDAVIT OF NO ASBESTOS, LEAD, AND PCB USE IN PROJECT

A. The use of a construction process or the installation of asbestos, lead, and PCBs or material containing asbestos, lead, and PCBs is strictly prohibited.

B. Prior to submitting a proposal, Offerors shall notify the Architect, in writing, if a specified material is known to contain or is likely to contain asbestos, lead, or PCBs.

C. The Offeror and subofferors agree to refrain from using products which are known to contain asbestos, lead, and PCB containing materials as applicable to the project. They shall affirm that lead or materials containing lead have not been incorporated into potable water systems, and that lead sheet flashing used in through roof plumbing penetration applications is the only lead on the Project.

D. The Selected Offeror and its subofferors shall execute Document 00 40 14 Affidavit of Non Asbestos, Lead, and PCB Use and submit at Project Closeout.

1.18 PROPOSAL EVALUATION WAIVER

A. By submitting a proposal, each offeror agrees to waive claims it has or may have against the Owner and its respective employees, the Program Manager, and their respective employees, the Architect/Engineer and consultants, and their respective employees, arising out of or in connection with the administration, evaluation, or recommendation of any proposal; waiver of any requirements under the Proposal Documents, acceptance or rejection of any proposals; and award of the contract.

B. Offerors shall execute Document 00 65 01 Proposal Evaluation Waiver and submit with the Proposal.

1.19 CONFLICT OF INTEREST QUESTIONNAIRE

A. According to Local Government Code, Chapter 176, a person or an agent of a person who contracts or seeks to contract for the sale or purchase of property, goods, or services with any local government agency must file a completed Conflict of Interest Questionnaire (CIQ) with the records administrator of the local government not later than the seventh business day after the date that the person begins contract discussions or negotiations with the Owner or submits to the Owner an application, response to a request for proposals or bids, correspondence, or another writing related to a potential agreement with the Owner.

B. Offerors and subofferors proposing to do work with the Owner shall execute Document 00 41 18 Conflict of Interest Questionnaire and submit to the Owner’s Legal Department within seven days of the Proposal Date.

1.20 AVAILABILITY OF MATERIALS AND SYSTEMS

A. A serious effort has been made to select materials that are systems that are readily available. To the extent known at proposal time specified items are available or within a relatively short period of time. If during the proposal period, should an Offeror become aware of an availability or delivery issue with the specified systems or materials, it should notify the Architect immediately. The Architect will promptly explore possibilities for selecting other systems or materials which would eliminate the issue and notify Offerors of changes by addendum. It shall be understood that only specified systems and materials that are readily available are included in the proposal.

1.21 DETERMINATION OF SUCCESSFUL RESPONDENT AND AWARD OF CONTRACT

A. In determining the Selected Offeror, the Owner will evaluate the information derived from Document 004500 Selection Criteria and Contractor Information Sheet.

B. A decision regarding determination of the successful Offeror will be rendered as soon as practicable.

C. Insofar as the Architect's recommendation to the Owner in determining the dollar amount of the Proposal of the responsible Offeror, only the Base Proposal will be considered; any monetary deduction proposed for using a Substitute Subcontractor (i.e., not one designated as a Listed Subcontractor) will not be a factor in the Architect's decision on which Offeror to recommend and if it is subsequently decided to accept any Substitute Subcontractor the substitution will be processed by Change Order.

1.22 USE OF ASBESTOS FREE MATERIALS, PRODUCTS AND SYSTEMS

A. The Offeror shall consider the use of asbestos free material requirements in preparing its Proposal including requirements during performance of the work regarding the use of asbestos free materials, products, and systems in the Project.

1. Since many materials, products and systems are proprietary, it is not possible to know the specific materials or components that produce each material, product or system without the manufacturer divulging trade secrets or patent information. Every effort has been made to specify materials, products, or systems, which do not contain asbestos.
2. It is the Contractor's responsibility to submit an affidavit from the manufacturer to ascertain that every material, product or system used in the Project does not contain asbestos. In the event a material, product, or system is found to contain asbestos, the Contractor shall offer for the Architect's consideration a substitution which it knows does not contain asbestos.
3. Although a material, product, or system is specified or a specification is based on a specific material, product, or system, the Contractor is not be relieved from its responsibility to ascertain that materials, products, and systems used in the Project do not contain asbestos. Under no circumstances shall a material, product, or system which is known, suspected, or found to contain asbestos be used on the Project.
4. If a material, product, or system containing asbestos is used, the Contractor shall remove and replace the material, product, or system with a comparable or better asbestos free material at no expense to the Owner, including removal and replacement of other materials affected by the removal of the asbestos containing material, product or system, i.e. removal, replacement, and finishing of gypsum board due to removal of asbestos insulation.

END OF DOCUMENT 00 20 00

DOCUMENT 00 31 00 – AVAILABLE INFORMATION

PART 1 - GENERAL

1.1 AVAILABLE INFORMATION

A. Informational Documents: The Owner is making certain documents available for the Bidders information. The Owner does not warrant the accuracy of the information contained with these documents. Bidders are encouraged to verify conditions prior to submitting their bid.
   1. Informational documents and reports are provided for convenience and are intended as information only. These documents are not a part documents of the Contract Documents.
   2. The Owner and Architect have no liability for the use of or interpretation of data from supplementary documents and reports provided for the bidder's information.
   3. Copies of informational documents are available upon request.

1.2 GEOTECHNICAL

A. Geotechnical Report: The geotechnical data prepared by the Owner's geotechnical consultant is made available for convenience. The report includes subsurface exploration and geotechnical evaluation includes location plan, exploration results, borings, general notes, soil classification system and supplemental recommendations for subsurface dry pit. It is intended to serve as additional information and is not in lieu of or replace the Contractor's own investigation. The geotechnical report is made available upon request through the Architect.
   1. The geotechnical report is not a part of the Contract Documents.
   2. Data indicated for subsurface conditions are not intended as representations or warranties of continuity of conditions. It is expressly understood the neither the Owner nor the Architect are not responsible for interpretations or conclusions drawn from the data by the Contractor.
      a. Data are made available for convenience and are not warranted to represent conditions that may be encountered. The Contractor may perform its own geotechnical evaluation of the site.
      b. The report identifies properties of below grade conditions and offers recommendations for the design of foundations, prepared primarily for the use of the Architect and Engineer.
      c. Do not construe recommendations described within the report as a requirement of the Contract, unless specifically referenced in the Contract Documents.
   3. The report, by its nature, cannot reveal every condition existing on the site. Should subsurface conditions be found to vary substantially from this report, changes in the design and construction of foundations will be made, with resulting credits or expenditures to the Contract Sum accruing to the Owner.

B. Boring Logs: Excerpts from the Geotechnical Report, including a Boring Plan, Boring Logs describing strata for each test hole, and results of laboratory tests, are bound herein, or if not bound herein, will be made available to Offerors by the Owner upon request.
   1. It is in the bidder's best interest to visit the site, review existing conditions and make investigations deemed necessary to verify site and subsurface conditions. Schedule investigations with the Architect.
   2. The Owner retains the right to retain a soils engineer to observe the execution of work in connection with excavating, trenching, filling, backfilling and grading.

GEOTECHNICAL ENGINEERING REPORT

Proposed New Wastewater Rehabilitation Office Building
North M Road
Edinburg, Texas

PSI Project No. 03282081

PREPARED FOR:

City of Edinburg
415 W. University Drive
Edinburg, Texas 78541

May 9, 2018

BY:

PROFESSIONAL SERVICE INDUSTRIES, INC.
2020 N. Loop 499, Ste 302
Harlingen, Texas 78550
Phone: (956) 423–6826
Fax: (956) 423–5735

Professional Service Industries, Inc.
2020 N. Loop 499, Ste 302
Harlingen, TX 78550
Office - 956.423.6826

May 9, 2018

City of Edinburg
415 W. University Drive
Edinburg, Texas 78541

Attn: Ms. Vanessa Velasquez

RE: GEOTECHNICAL ENGINEERING REPORT
PROPOSED NEW WASTEWATER REHABILITATION OFFICE BUILDING
NORTH M ROAD
EDINBURG, TEXAS
PSI Project No. 03282081

Dear Ms. Velasquez:

Professional Service Industries, Inc. (PSI), an Intertek company, is pleased to submit this Geotechnical Engineering Report for the referenced project. This report includes the results of field and laboratory testing along with recommendations for use in preparation of the appropriate design and construction documents for this project.

PSI appreciates the opportunity to provide this Geotechnical Engineering Report and looks forward to continuing participation during the design and construction phases of this project. If there are any questions pertaining to this report, or if PSI may be of further service, please contact the PSI office.

PSI also has great interest in providing materials testing and inspection services during the construction of this project. If you will advise us of the appropriate time to discuss these engineering services, we will be pleased to meet with you at your convenience.

Respectfully submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.
Texas Board of Professional Engineers Certificate of Registration # F003307

Rockford Miller, E.I.T.
Geotechnical Services
Project Manager

Richard E. Webb, P.E.
Principal Consultant



May 9, 2018

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1.0 PROJECT INFORMATION

1.1 PROJECT AUTHORIZATION

Professional Service Industries, Inc., (PSI), an Intertek company, has completed a field exploration and geotechnical evaluation for the proposed New Wastewater Rehabilitation Office Building project to be constructed on North M Road at the existing wastewater treatment plant in Edinburg, Texas. Ms. Vanessa Velasquez, representing the City of Edinburg, authorized PSI's services on March 13, 2018 by issuing Purchase Order No. P180725 with respect to PSI Proposal No. 234911R1 dated February 22, 2018. PSI's proposal contained a proposed scope of work, lump sum fee, and PSI's General Conditions.

1.2 PROJECT DESCRIPTION

Based on information provided, the project consists of the development of a new office building with three proposed locations. The results of this geotechnical investigation, a summary of the proposed project and geotechnical recommendations are presented in the following table.

TABLE 1.1: GENERAL PROJECT DESCRIPTION

Structure	One, New Office Building
Structural Foot Print	±1,000 square feet
Construction Type	Unknown
Existing Grade Change within Building Pad	± 2 feet estimate (No Topographic Information)
Existing Grade Change within Project Site	± 2 feet estimate (No Topographic Information)
Finished Floor Elevation	Unknown
Requested Foundation Type	Monolithic Stiffened Beam and Slab on Grade
Assumed Maximum Column Loading	Less than 150 kips
Assumed Maximum Wall Loading	Less than 1.5 kips per lineal foot
General Subsurface Conditions	Sandy Lean Clay, Lean Clay w/ Sand overlying Clayey Sand (Section 2.5)
Groundwater Observations	15 feet (Section 2.5.1)
Estimated Shrink Swell Movements	Approximately 1 inch (Section 3.2.1)
Tolerable Floor/Foundation Movements	Total: Approximately 1 inch Differential: Approximately ½ inch
Slab-on-Grade Earthwork Recommendation	Reconditioning Method (section 3.3.1)
Foundation Design Recommendations	Stiffened Beam and Slab-on-Grade (Section 3.5)
Allowable Bearing Pressure	2,500 psf (Section 3.5)
Site Seismic Class	Class D (Section 3.6)

The geotechnical recommendations presented in this report are based on the available project information, structure locations, and the subsurface materials described in this report. If any of the noted information or assumptions made are incorrect, please inform PSI so that the recommendations presented in this report can be amended as necessary. PSI will not be responsible for the implementation of provided recommendations if not notified of changes in the project.

1.3 PURPOSE AND SCOPE OF SERVICES

The purpose of this study is to evaluate the subsurface conditions at the site and develop geotechnical engineering recommendations and guidelines for use in preparing the design and other related construction documents for the proposed project. The scope of services included drilling borings, performing laboratory testing, and preparing this geotechnical engineering report.

This report briefly outlines the available project information, describes the site and subsurface conditions, and presents the recommendations regarding the following:

- General site development and subgrade preparation,
- Estimated potential soil movements associated with shrinking and swelling soils and methods to reduce these movements to acceptable levels;
- Recommendations for site excavation, fill compaction, use of on-site and imported fill material in the area of the structure and under pavements;
- Recommendations for building pad preparation for ground supported slabs having an approximate movement potential, due to heave or settlement, of 1-inch;
- Recommendations for design of foundations to be used for support of the proposed structure, including Wire Reinforcing Institute (WRI) and Post-Tensioning Institute (PTI) design criteria for slab-on-grade foundations;
- Seismic design site classification per the 2012/2015 International Building Code;
- Recommendations for the design of flexible asphaltic and rigid concrete pavement systems for the proposed parking and drive areas.

The scope of services for this geotechnical exploration did not include an environmental, mold nor detailed seismic/fault assessment for determining the presence or absence of wetlands, or hazardous or toxic materials in the soil, bedrock, surface water, groundwater, or air on or below, or around this site. Any statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes.

2.0 SITE AND SUBSURFACE CONDITIONS

2.1 SITE DESCRIPTION

The following table provides a generalized description of the existing site conditions based on visual observations during the field activities and other available information.

TABLE 2.1: SITE DESCRIPTION

Site Location	WGS84 (26.308836°, -98.136230°)
Site History	Developed wastewater treatment plant
Existing Site Ground Cover	Grass and pavement
Existing Grade/Elevation Changes	Relatively flat
Project Boundaries	North - Wastewater treatment plant East - Wastewater treatment plant South - Access road West - North M Road

2.2 FIELD EXPLORATION

Field exploration for the project consisted of drilling a total of three (3) borings. The boring design element, boring labels, and approximate depths are provided in the following table.

TABLE 2.2: FIELD EXPLORATION SUMMARY

Design Element	Boring Label	Boring Location	Approx. Depth of Boring
Building	B-2	Option-A	25 feet
Building	B-1	Option-B	25 feet
Building	B-3	Option-C	25 feet

The boring locations were selected by PSI personnel and were located in the field using available landmarks and GPS coordinates using a recreation-grade device. Elevations of the ground surface at the boring locations were not provided to PSI and should be surveyed by others, if required. Therefore, the references to elevations of various subsurface strata are based on depths below existing grade at the time of drilling. The approximate boring locations are depicted on the Boring Location Plan provided in the Appendix.

TABLE 2.3: FIELD EXPLORATION DESCRIPTION

Drilling Equipment	Truck-mounted drilling equipment
Drilling Method	Continuous-Flight Auger
Drilling Procedure	Applicable ASTM and PSI Safety Manual
Sampling Procedure	ASTM D1587/1586
Field Testing Procedures	Hand Penetrometers Standard Penetration Test (ASTM D1586)

Frequency of Groundwater Level Measurements	During Drilling and After Drilling
Boring Backfill Procedures	Soil Cuttings and Asphalt Patch at B-3
Sample Preservation and Transportation Procedure	General accordance with ASTM D4220

During the field activities, the encountered subsurface conditions were observed, logged, and visually classified (in accordance with ASTM D2488). Field notes were maintained to summarize soil types and descriptions, water levels, changes in subsurface conditions, and drilling conditions.

2.3 LABORATORY TESTING PROGRAM

PSI supplemented the field exploration with a laboratory testing program to determine additional engineering characteristics of the subsurface soils encountered. The laboratory testing program included:

- Visual Classification (ASTM D2487),
- Moisture Content Tests (ASTM D2216),
- Atterberg Limits (ASTM D4318),
- Material Finer than No. 200 (ASTM D1140),
- Unified Soil Classification System (ASTM D2487), and
- Unconfined Compression Strength Test (ASTM D2166).

The laboratory testing program was conducted in general accordance with applicable ASTM Methods. The results of the laboratory tests are provided in the Appendix on the Logs of Boring. Portions of samples not altered or consumed by laboratory testing will be retained for 60 days from the date shown this report and will then be discarded.

2.4 SITE GEOLOGY

As shown on the Geologic Atlas of Texas, McAllen-Brownsville Sheet, reprinted in 1979, the site is located in an area where the **Lissie Formation (Ql)** has been mapped to be at or near the ground surface. The formation is from the mid-Pleistocene Epoch. This formation consists sand, silt, clay and small amounts of gravel with interbedded layers of sandy caliche that have been locally cemented.

2.5 SUBSURFACE CONDITIONS

The results of the field and laboratory testing have been used to develop a generalized surface profile of the project site. The following subsurface descriptions highlight the major subsurface stratification features and material characteristics. This soil profile descriptions have been summarized in the following table.

TABLE 2.4: GENERALIZED SOIL PROFILE

Layer	Depth of Layer (ft)		Soil Type	Ave. ω (%)	Ave. LL (%)	Ave. PI	Ave. % Pass. #200
	Top	Bot.					
1	0	6	Sandy Lean Clay	14	38	21	63
2	6	18	Lean Clay with Sand	22	40	26	77
3	18	25	Clayey Sand	25	32	15	45

The boring logs included in the Appendix should be reviewed for specific information at individual boring locations. The boring logs include soil descriptions, stratifications, locations of the samples, and field and laboratory test data. The stratifications shown on the boring logs represent the conditions at the actual boring location and present the approximate boundaries between subsurface materials. The actual transitions between strata may be more gradual or more distinct. Variations will occur and should be expected across the site.

2.5.1 GROUNDWATER INFORMATION

Water level measurements were performed during drilling and after completion of drilling. Specific information concerning groundwater is noted on each boring log presented in the Appendix of this report. The groundwater measurements are summarized in the following table.

TABLE 2.5: GROUNDWATER LEVELS (DEPTHS)

Boring Designation	Boring Depth (feet)	During Drilling (feet)	After Drilling (feet)
B-1	25	18.5	15
B-2	25	18	15.5
B-3	25	18	15.5

Groundwater levels fluctuate seasonally as a function of rainfall, proximity to creeks, rivers and lakes, the infiltration rate of the soil, seasonal and climatic variations and land usage. If more detailed water level information is required, observation wells or piezometers could be installed at the site, and water levels could be monitored.

The groundwater levels presented in this report are the levels that were measured at the time of our field activities. It is recommended that the contractor be prepared to control groundwater, if encountered, during construction.

3.0 GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

3.1 GEOTECHNICAL DISCUSSION

Based upon the information gathered from the soil borings and laboratory testing, the clay soils encountered at this site have a low potential for expansion. PSI recommends the expansive potential (i.e. "Potential Vertical Movement" or PVM) of these soils be addressed in the design and construction of this project to reduce the potential for foundation movements and foundation distress.

PSI recommends an improved foundation pad be constructed under soil-supported floor slab and foundation elements due to the presence of expansive foundation soils. Several methods are available to reduce the PVM and increase the strength of the foundation soil beneath a grade-supported foundation or floor slab. These methods include:

- Excavating unacceptable soils and replacing them with select fill materials, *(Undercut and Replace Method)*
- Excavation and moisture conditioning of onsite or imported general fill for use as density and moisture controlled engineered fill, *(Reconditioning Method)*
- Chemical injection of the expansive or unacceptable soils. *(Injection Method)*

The most cost-effective method for a given site is typically a function of site-specific conditions and climate conditions anticipated at the time of construction.

Based upon our experience on similar projects, we have provided recommendations for a soil-supported stiffened beam and slab-on-grade type foundation (Waffle Slab) supported on a foundation pad constructed using the Reconditioning Method.

The following design recommendations have been developed based on the previously described project characteristics and subsurface conditions encountered. If there are changes in the project criteria, PSI should be retained to review the changes and determine if modifications of the recommendations presented in this report will be required. The findings of such a review would be presented in a supplemental report. Once final design plans and specifications are available, a general review by PSI is recommended to verify that the earthwork and foundation recommendations are properly interpreted and implemented within the construction documents.

3.2 POTENTIAL VERTICAL MOVEMENT OF EXPANSIVE SOILS

The soils encountered at the soil boring locations exhibit a low potential for volumetric changes, due to fluctuations in soil moisture content. PSI has conducted laboratory testing on the soils to estimate the expansive soil potential with soil moisture variations. These soil moisture variations are based on historical climate change data. Determining the soil potential for shrinking and swelling, combined with historical climate variation, aids the engineer in quantifying the soil movement potential of the soils supporting the floor slab and shallow foundations. Various shrink/swell movement procedures, and two soil modeling systems, the Post Tensioning Institute's (PTI) "Design of Post-Tensioned Slabs-on-Ground, 3rd Edition" and Texas Department of Transportation (TxDOT) method TEX-124-E, were used to estimate the Potential Vertical Movement (PVM) for this location.

3.2.1 SHRINK/SWELL MOVEMENT (PVM) ESTIMATE

Based on laboratory testing results, and the TEX-124-E and the PTI methods, the potential vertical movement within the proposed project area was estimated to be approximately **1 inch ± ½ inch**.

It is not possible to accurately quantify actual soil moisture changes and resulting shrink/swell movements. The PVM and referenced structural movements values provided should not be considered absolute values that could occur but approximate values based on industry standard practice and experience. Extreme soil moisture variations could occur due to unusual drought severity, leaking water or sewer lines, poor drainage (possibly due to landscape changes after construction), irrigation line breaks, perched groundwater infiltration, springs, soil desiccation from large trees located adjacent to the building or previously underneath the building, downspouts directing roof discharge under the foundation, etc. Therefore, because of these unknown factors, the shrink/swell potential of soils in Texas can often be significantly underestimated using the previously mentioned methods of evaluating PVM.

The unknown factors previously mentioned cannot be determined at the time of the geotechnical study. Therefore, estimated shrink/swell movements are calculated only in consideration of historical climate data related to soil moisture variations. Movements exceeding those estimated should be anticipated and routine maintenance should be provided to address these issues throughout the life of the structure.

3.2.2 DESIGN PVM CONSIDERATIONS

Grade-supported floor slabs and foundations should be expected to undergo some vertical movements, including differential, due to the action of expansive soils and possible soil settlement. In this general area, most owners, architects, structural and geotechnical engineers consider a value of one inch or less to be within acceptable movement tolerances for grade-supported floor slabs or foundations. This generally accepted tolerance for movement has been used by PSI in developing the recommendations for preparing the foundation pad for this project.

The amount of structural movement associated with a PVM magnitude of one inch may not be considered acceptable per “operational” or “aesthetic” performance criteria, which often occur at less movement than the magnitude of the PVM which is based on “structural” considerations. Cracking in the foundation and walls and sticking doors, which requires periodic maintenance, will likely occur for foundations designed using an allowable one-inch PVM. This should be understood by the Owner and Design Team.

PSI recommends that the Owner discuss allowable movement tolerances with the structural engineer, architect, and other members of the Design Team prior to commencement of the final design to make certain that appropriate movement tolerances are developed and used for this project. If design PVM values other than one inch is desired, PSI should be contacted to review and revise the recommendations presented in this report as necessary to meet the project requirements.

3.3 FOUNDATION DISCUSSION

Based on information provided to PSI, information obtained during the field operations, results of the laboratory testing, and PSI’s experience with similar projects, recommendations for a soil-supported stiffened beam and slab-on-grade foundation (Waffle Slab) is presented in this report. Should it be determined that a different foundation type is desired, please inform PSI as soon as possible so that a supplement to this report for the desired foundation type can be provided.

3.3.1 SLAB-ON-GRADE EARTHWORK RECOMMENDATIONS

Foundation pad improvement should consist of removing the upper soils to the recommended minimum over-excavation depth, compacting the exposed subgrade, placement and compaction of moisture conditioned common fill in areas between the top of the compacted subgrade up to the bottom of the select fill, and finally placement and compaction of select fill to finish floor grade. This procedure is outlined in the following sections.

3.3.1.1 *RECONDITIONING METHOD*

The following illustration and table provide general recommendations for the installation of a foundation pad using the Reconditioning Method.

TABLE 3.1: RECONDITIONING METHOD RECOMMENDATIONS

Application	Soil-Supported Floor Slab
Site Stripping Removal	Upper 6 inches of organics and deleterious material including debris to expose clean subgrade
Foundation Improvement Method	Remove and replace existing soils with moisture conditioned soil and/or select fill
Improved Site Condition PVM	Approximately 1 inch
Minimum Over-Excavation	2 feet
Horizontal Undercut Extent	Below slab areas and at least 5 feet beyond the slab perimeter and **extending the full width of flatwork that may be sensitive to movement**
Subgrade Proof-Rolling Requirements	Proof-rolled with construction equipment weighing at least 20 tons. Soils that are observed to rut or deflect excessively under the moving load should be removed and replaced with properly compacted select fill materials.
Exposed Subgrade Treatment	Proof-roll then scarify, moisture condition, and compact 9 inches subgrade below base of undercut
Select Fill Thickness	**Minimum to raise to slab to FFE**
Select Fill Material	Pit Run Free of organics, trash, or other deleterious material Liquid Limit <40% Plasticity Index 7 to 20 Max Particle Size < 3”
Reconditioned Fill Minimum Thickness	2 feet
Reconditioned Fill Requirements	On site having: Allowable PI from 12 to 35 Percent Passing No. 200 Sieve > 50% Max Particle Size < 3”
Structural Common Fill Requirements	Clean on-site materials having: Allowable PI from 12 to 35 Percent Passing No. 200 Sieve > 50% Max Particle Size < 3”
Vapor Retarder Material	Minimum 10-mil conforming to ASTM E1745, Class C or better and with a maximum water vapor permeance of 0.044 perms (ASTM E96) such as a 10 mil Stego Wrap by Stego Industries LLC or other similar product

Maximum Loose Lift Thickness	8 inches
Time Between Reconditioned Fill and Select Fill Placement	Less than 48 hours

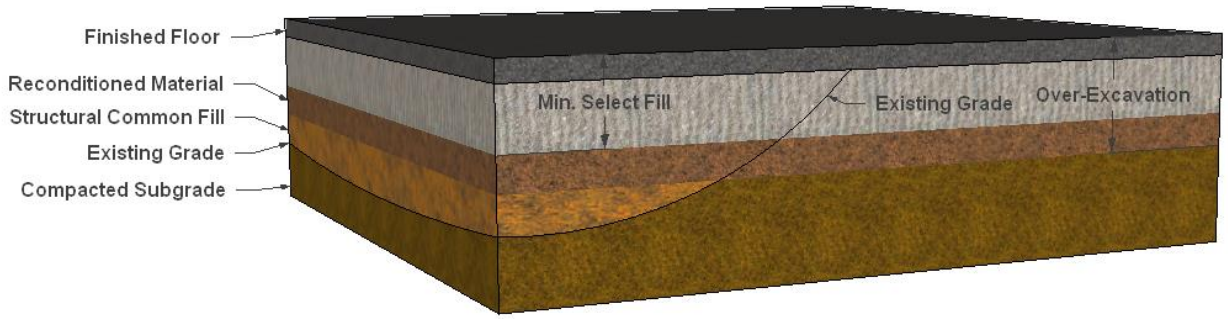


FIGURE 3.1: RECONDITIONING METHOD PAD IMPROVEMENT

3.3.2 COMPACTION AND TESTING REQUIREMENTS FOR FOUNDATION PAD AREAS

The following table outlines foundation pad compaction recommendations.

TABLE 3.2: COMPACTION REQUIREMENTS RECONDITIONING METHOD

Location	Material	Test Method for Density Determination	Percent Compaction	Optimum Moisture Content	Testing Frequency
Foundation Pad Areas	Subgrade Soil (Base of excavation)	ASTM D 698	94% to 98%	0 to +4%	1 per 5,000 SF
	Reconditioned Fill	ASTM D 698	94% to 98%	+1 to +4%	1 per 5,000 SF; min. 3 per lift
	Select Fill (Item 247 or Pit Run)	ASTM D 698	≥ 98%	–1 to +3%	1 per 5,000 SF; min. 3 per lift

3.4 DESIGN MEASURES TO REDUCE CHANGES IN SOIL MOISTURE

The following recommended measures can reduce possible moisture fluctuations of the soils under the floor slab. Movements of the foundation soil can be effectively reduced by providing horizontal and/or vertical moisture barriers around the edge of the slab. Typically, the moisture barriers would consist of concrete flatwork or asphalt or concrete pavement placed adjacent to the edge of the building, a clay cap over poly sheeting, and/or a deepened perimeter grade beam or vertical trench filled with flowable fill or concrete.

Although subgrade modification is recommended to reduce potential soil-related foundation movements, the design and construction of a grade-supported foundation should also include the following elements:

- *Roof drainage should be controlled by gutters and carried well away from the structure.*
- *The ground surface adjacent to the building perimeter should be sloped and maintained a minimum of 5% grade away from the building for 10 feet to result in positive surface flow or*

drainage away from the building perimeter. In areas adjacent to the building controlled by ADA, concrete flatwork slopes should not be less than 2% within 10 feet of the building.

- *Hose bibs, sprinkler heads, and other external water connections should be placed well away from the foundation perimeter such that surface leakage cannot readily infiltrate into the subsurface or compacted fills placed under the proposed foundations and slabs.*
- *No trees or other vegetation over 6 feet in height shall be planted within 15 feet of the structure unless specifically accounted for in the foundation design.*
- *Utility bedding should not include gravel near the perimeter of the foundation. Compacted clay or flowable fill trench backfill should be used in lieu of permeable bedding materials between 2 feet inside the building to 4 feet beyond the exterior of the building edge to reduce the potential for water to infiltrate within utility bedding and backfill material.*
- *Paved areas around the structure are helpful in maintaining soil moisture equilibrium. It will be very beneficial to have pavement, sidewalks or other flatwork located immediately adjacent to the building to both reduce intrusion of surface water into the more permeable select fill and to reduce soil moisture changes along the exterior portion of the floor due to soil moisture changes from drought, excessive rainfall or irrigation, etc. The use of a clay cap over poly sheeting (horizontal barrier) or impervious geosynthetic liner or concrete (vertical barrier) is recommended in those areas not covered with asphalt or concrete pavement or flatwork. For this project, the minimum recommended horizontal distance of relatively impervious cover from pavement, flatwork, clay cap over poly sheeting or geosynthetic liner is 8 feet.*
- *Flower beds and planter boxes should be piped or water tight to prevent water infiltration under the building.*
- *Experience indicates that landscape irrigation is a common source of foundation movement problems and pavement distress. Repairing irrigation lines as soon as possible after leakage commences will benefit foundation performance greatly.*
- *Foundation pad and pavement subgrade should be protected and covered within 48 hours to reduce changes in the natural moisture regime from rainfall events or excessive drying from heat and wind.*

3.5 FOUNDATION DESIGN RECOMMENDATIONS

3.5.1 STIFFENED BEAM AND SLAB-ON-GROUND FOUNDATION RECOMMENDATIONS

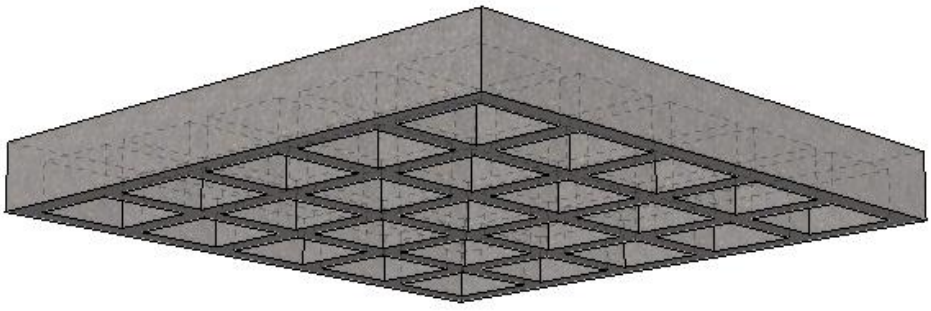


FIGURE 3.2: TYPICAL STIFFENED BEAM AND SLAB-ON-GRADE SLAB

A stiffened beam and slab-on-grade foundation (waffle slab) is generally used to support relatively light structures where soil conditions are relatively uniform and where uplift and settlement can be tolerated. The intent of a stiffened beam and slab-on-grade foundation is to allow the structure and foundation to move with soil movements while providing sufficient stiffness to limit differential movements within the superstructure to an acceptable magnitude. The foundation may be designed using the Design of Slab-On-Ground Foundations published by the Wire Reinforcement Institute, Inc. (August 1981, updated March 1996). Alternately, the foundation may be designed using the 3rd Edition of the Design of Post-Tensioned Slabs-on-Ground published by the Post-Tensioning Institute (PTI DC10.1-08). The following table is applicable for a conventionally reinforced "Waffle Slab" with foundation pad prepared in accordance with Section 3.3.1.

TABLE 3.3: WRI DESIGN PARAMETERS

Effective Plasticity Index	25.0
Soil/Climatic Rating Factor (1–C)	0.11
Allowable Bearing Pressure for Grade Beams	2,500 psf
Bearing Stratum at Bottom of Grade Beams	Compacted Lean Clay (Reconditioned Fill) or Select Fill
Penetration of Perimeter Beams Below Final Exterior Grade	At least 24 inches

PSI is providing PTI design values for the Structural Engineer's consideration and possible use. These design values are estimated from the "Volflo" computer program in consideration of the soil conditions in the building area, an improved foundation pad, and local experience. The following table is applicable for a conventionally reinforced or post-tensioned slab-on-grade with foundation pad prepared in accordance with Section 3.3.1.

TABLE 3.4: PTI DESIGN PARAMETERS

Edge Moisture Variation Distance	
Center Lift, e_m	9.0 feet
Edge Lift, e_m	4.8 feet
Differential Soil Movement	
Center Lift, y_m	-0.8 inches
Edge Lift, y_m	1.2 inches
Allowable Bearing Pressure for Grade Beams	2,500 psf
Bearing Stratum at Bottom of Grade Beams	Compacted Lean Clay or Select Fill
Penetration of Perimeter Beams Below Final Exterior Grade	At least 24 inches

Utilities that project through slab and grade beam foundations should be designed either with some degree of flexibility or with sleeves to help prevent potential damage to these lines resulting from vertical movement. Contraction, control, or expansion joints should be designed and placed in various portions of the structure to reduce and control wall cracking as a result of foundation movements. Properly planned placement of these joints will assist in controlling the degree and location of material cracking which normally occurs due to material shrinkage, thermal affects, soil movements and other related structural conditions.

3.6 SITE SEISMIC DESIGN RECOMMENDATIONS

For the purposes of seismic design, based on the encountered site conditions and local geology, PSI interpreted the subsurface conditions to satisfy the **Site Class D** criteria for use at this site as defined by the International Building Code (IBC). The site class is based on the subsurface conditions encountered at the soil borings, the results of field and laboratory testing, experience with similar projects in this area, and considering the site prepared as recommended herein. The table below provides recommended seismic parameters for the project based on the 2012/15 edition of the IBC.

TABLE 3.5: RECOMMENDED DESIGN SEISMIC PARAMETERS

Seismic Parameter	IBC 2012/15
0.2 sec (S_S)	0.044g
1.0 sec (S_1)	0.015g
Site Coefficient 0.2sec, F_a	1.6
Site Coefficient 1.0 sec, F_v	2.4
0.2 sec (S_{DS})	0.046g
1.0 sec (S_{D1})	0.024g

4.0 PAVEMENT DESIGN RECOMMENDATIONS

4.1 PAVEMENT DESIGN PARAMETERS

PSI understands that flexible and rigid pavements will be considered for this project. Therefore, pavement design recommendations for several levels of traffic loading were developed based on assumptions of potential traffic, drive paths or patterns and anticipated soil support characteristics of pavement subgrades. PSI utilized the "AASHTO Guide for Design of Pavement Structures" published by the American Association of State Highway and Transportation Officials to evaluate the pavement thickness recommendations in this report. This method of design considers pavement performance, traffic, roadbed soil, pavement materials, environment, drainage and reliability. Each of these items is incorporated into the design methodology. PSI is available to provide laboratory testing and engineering evaluation to refine the site-specific design parameters and sections, upon request.

Specific design traffic types and volumes for this project were not available to PSI at the issuance of this report. This traffic information is typically used to determine the number of 18-kip Equivalent Single Axle Loads (ESAL) that is applied to the pavement over its design life. Furthermore, the scope of services for this project did not include California Bearing Ratio (CBR) testing. In lieu of project specific design parameters, general traffic and subgrade parameter assumptions were used for this design. Based on this information, PSI has provided recommended pavement sections for "light duty" and "heavy duty" pavements constructed on stable and properly prepared/compacted subgrades. Details regarding the basis for this design are presented in the table below.

TABLE 4.1: PAVEMENT DESIGN PARAMETERS AND ASSUMPTIONS (RIGID AND FLEXIBLE)

Reliability, percent	75
Initial Serviceability Index, Flexible Pavement	4.2
Initial Serviceability Index, Rigid Pavement	4.5
Terminal Serviceability Index	2.0
Traffic Load for Light Duty Pavement	15,000 equivalent single axle loads (ESALs)
Traffic Load for Heavy Duty Pavement	150,000 equivalent single axle loads (ESALs)
Standard Deviation, Flexible Pavement	0.45
Standard Deviation, Rigid Pavement	0.35
Concrete Compressive Strength	4,000 psi
Subgrade California Bearing Ratio (CBR)	3 for clay subgrade
Subgrade Modulus of Subgrade Reaction, k in pci	100 for clay subgrade

Pavements supported on expansive soils will be subjected to PVM soil movements estimated and presented previously in this report. These potential soil movements typically occur to some degree during the life of the pavement. Consequently, pavements can be expected to crack and require periodic maintenance to reduce damage to the pavement structure.

Light-duty areas include parking and drive lanes that are subjected to passenger vehicle traffic only and exclude entrance aprons and general and single access roadway drives to the parking lot area.

Heavy-duty areas include areas subjected to drive lanes, access drives, 18-wheel tractor trailers, including loading and unloading areas, and areas where truck turning and maneuvering may occur.

An eight-inch thick concrete pavement is recommended for dumpster pad areas and that area leading up to the dumpster pad.

During the paving life, maintenance to seal surface cracks within concrete or asphalt paving and to reseal joints within concrete pavement should be undertaken to achieve the desired paving life. Perimeter drainage should be controlled to prevent or retard influx of surface water from areas surrounding the paving. Water penetration leads to paving degradation. Water penetration into base or subgrade materials, sometimes due to irrigation or surface water infiltration leads to pre-mature paving degradation. Curbs should be used in conjunction with asphalt paving to reduce potential for infiltration of moisture into the base course. Curbs should extend the full depth of the base course and should extend at least 3 inches into the underlying clayey subgrade. The base layer should be tied into the area inlets to drain water that may collect in the base.

Material specifications, construction considerations, and section requirements are presented in following sections.

The presented recommended pavement sections are based on the field and laboratory test results for the project, local pavement design practice, design assumptions presented herein and previous experience with similar projects. The project Civil Engineer should verify that the ESAL and other design values are appropriate for the expected traffic and design life of the project. PSI should be notified in writing if the assumptions or design parameters are incorrect or require modification.

4.2 PAVEMENT SECTION RECOMMENDATIONS

PSI anticipated that the roadways and parking areas will be used primarily by passenger vehicles and delivery vehicles. PSI is providing pavement thickness sections based on experience with similar facilities constructed on similar soil conditions for the design traffic loading anticipated.

4.2.1 FLEXIBLE PAVEMENT

The proposed pavement areas for this project may be constructed with flexible asphaltic concrete pavement. Recommendations for flexible asphaltic concrete pavements are provided below.

TABLE 4.2: FLEXIBLE PAVEMENT SECTION OPTIONS

Material	Thickness	
Traffic Type	Light	Heavy
Hot Mix Asphaltic Concrete	2”	3”
Import Flexible Base	7”	10”
Compacted Subgrade	8”	

4.2.2 RIGID PAVEMENT

The proposed pavements for this project may also be constructed with rigid concrete pavement. Recommendations for rigid concrete pavement areas are provided below.

TABLE 4.3: RIGID PAVEMENT SECTION OPTIONS

Material	Thickness	
Traffic Type	Light	Heavy
Portland Cement Concrete	5”	7”
Compacted Subgrade	8”	

4.2.3 GENERAL PAVEMENT DESIGN AND CONSTRUCTION RECOMMENDATIONS

TABLE 4.4: PAVEMENT DESIGN AND CONSTRUCTION RECOMMENDATIONS

Minimum Undercut Depth	6 inches or as needed to remove roots
Reuse Excavated Soils	Free of roots and debris and meet material requirements of intended use
Undercut Extent	2 feet beyond the paving limits
Exposed Subgrade Treatment	Proof-roll with rubber-tired vehicle weighing at least 20 tons. A representative of the Geotechnical Engineer should be present during proof-roll.
Proof-Rolled Pumping and Rutting Areas	Excavate to firmer materials and replace with compacted general or select fill under direction of a representative of the Geotechnical Engineer
General Fill Requirements	Materials free of roots, debris, and other deleterious materials with a maximum rock size of 4 inches with a CBR greater than 3
Minimum General Fill Thickness	As required to achieve grade
Maximum General Fill Loose Lift Thickness	9 Inches
Imported Flexible Base Requirements	TxDOT Item 247, Type A, Grade 1 or 2
Maximum Flexible Base Loose Lift Thickness	9 Inches
Hot Mix Asphaltic Concrete	TxDOT Item 340, Type C or D
Concrete Minimum Recommended Strength	4,000 psi (avg. 28-day comp. strength)
Concrete Min. Recommended Reinforcement to Reduce Cracking	No. 4 bars, 18 inches on-center, each way Located in top half of concrete section Minimum 2 inches cover 14-inch long dowels spaced 12 inches on-center at construction joints
Contraction Joint Spacing	Per ACI 330, common practice indicates that the maximum joint spacing should be less than 30 times the thickness of the concrete pavement or 15 feet, whichever is smaller.

TABLE 4.5: COMPACTION AND TESTING RECOMMENDATIONS FOR PAVEMENT AREAS

Location	Material	Test Method for Density Determination	Percent Compaction	Optimum Moisture Content	Testing Frequency
Pavement Areas	Scarified On-site Soil (Subgrade)	ASTM D 698	94% to 98%	0 to +4%	1 per 7,500 SF; min. 3 tests
	General Fill (Onsite Material)	ASTM D 698	94% to 98%	0 to +4%	1 per 10,000 SF; min. 3 per lift
	Base Material	ASTM D 1557 TEX-113-E	≥ 95% ≥ 100%	±3% ±2%	1 per 5,000 SF; min. 3 per lift

5.0 CONSTRUCTION CONSIDERATIONS

PSI should be retained to provide observation and testing of construction activities involved in the foundations, earthwork, pavements and related activities of this project. PSI cannot accept any responsibility for any conditions which deviate from those described in this report, nor for the performance of the foundations or pavements if not engaged to also provide construction observation and materials testing for this project. The PSI geotechnical engineer-of-record should be retained to provide continuing geotechnical engineering consulting and construction document review, even if periodic on-call testing is contracted with PSI Construction Services.

5.1 INITIAL SITE PREPARATION CONSIDERATIONS

5.1.1 SUBGRADE PREPARATION FOR SITE WORK OUTSIDE BUILDING PAD AND PAVEMENT AREAS

Grade adjustments outside of the foundation pad and pavement areas can be made using select or general fill materials. The clean excavated onsite soils may also be reused in areas not sensitive to movement.

TABLE 5.1: SUBGRADE PREPARATION FOR NON-STRUCTURAL - GENERAL FILL

Minimum Undercut Depth	6 inches or as needed to remove roots, organic and/or deleterious materials
Exposed Subgrade Treatment	Proof-roll with rubber-tired vehicle weighing at least 20 tons. A representative of the Geotechnical Engineer should be present during proof-roll.
Proof-Rolled Pumping and Rutting Areas	Excavate to firmer materials and replace with compacted general or select fill under direction of a representative of the Geotechnical Engineer
General Fill Type	Clean material free of roots, debris and other deleterious material with a maximum particle size of 4 inches
Maximum General Fill Loose Lift Thickness	8 inches

TABLE 5.2: FILL COMPACTION RECOMMENDATIONS OUTSIDE OF BUILDING AND PAVEMENT AREAS

Location	Material	Test Method for Density Determination	Percent Compaction	Optimum Moisture Content	Testing Requirement
Outside of Structure or Pavement Areas	General Fill	ASTM D 698	≥ 95%	0 to +4%	1 per 10,000 SF; min. 3 per lift

5.1.2 EXISTING SITE CONDITIONS

The following table outlines construction considerations in consideration of demolition of existing structures, demolition of existing paving, procedures for abandoning old utility lines and removing trees.

TABLE 5.3: CONSIDERATIONS FOR DEMOLITION

Existing Structures	
Foundations of former structure(s) located below new structure	Impact of foundation of former structures should be evaluated on a case by case basis
Foundations for former structure(s) located below new paving	Cut off at least 3 feet below finished paving grade
Existing Pavement	
Former paving located within footing of proposed structure(s)	Remove concrete and/or HMAC surface course and base entirely or review impact on case by case basis
Former paving located within footprint of proposed new paving	Remove concrete and/or HMAC surface course and evaluate if base can be reused
Abandoned Utilities	
Utilities of former structure(s) located within new foundation pad/footprint of proposed structure	Remove pipe, bedding and backfill and then replace with select fill placed using controlled compaction
Utilities of former structure(s) located outside of foundation pad footprint	Abandon in place using a grout plug
Tree Removal	
Trees located within proposed building footprint; roadways, parking, and sidewalk areas; and 5 feet of building area	Remove root system for full vertical and lateral extent and extend removal for at least 3 feet beyond presence of any root fragment and replace void with compacted general fill or flowable fill

5.2 MOISTURE SENSITIVE SOILS/WEATHER RELATED CONCERNS

Clayey soils are sensitive to disturbances caused by construction traffic and changes in moisture content. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in the soil strength and support capabilities. In addition, clayey soils which become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. It will, therefore, be advantageous to perform earthwork, foundation, and construction activities during dry weather.

5.3 BUILDING FOUNDATION EXCAVATION OBSERVATIONS

The foundation excavations should be observed by a representative of PSI prior to reinforcing steel or concrete placement to assess that the foundation materials are capable of supporting the design loads and are consistent with the materials discussed in this report. This is especially important to identify the condition and acceptability of the exposed subgrades under the foundation. Soft or loose soil zones encountered at the bottom of the beam excavations should be removed to the level of competent soils as directed by the Geotechnical Engineer. Cavities formed as a result of excavation of soft or loose soil zones should be backfilled with compacted select fill or flowable fill.

After opening, excavations should be observed and concrete placed as quickly as possible to avoid exposure to wetting and drying. Surface run-off water should be drained away from the excavations and not be allowed to pond. If excavations must be left open an extended period, they should be protected to reduce evaporation or entry of moisture.

5.4 DRAINAGE CONSIDERATIONS

Water should not be allowed to collect in or adjacent to foundation excavations, on foundation surfaces, or on prepared subgrades within the construction area either during or after construction. Proper drainage around grade supported sidewalks and flatwork is also important to reduce potential movements. Excavated areas should be sloped toward one corner to facilitate removal of any collected rainwater, groundwater, or surface runoff. Providing rapid, positive drainage away from the building will reduce moisture variations within the underlying soils and will therefore provide a valuable benefit in reducing the magnitude of potential movements.

5.5 EXCAVATIONS AND TRENCHES

Excavation equipment capabilities and field conditions may vary. Geologic processes are erratic and large variations can occur in small vertical and/or lateral distances. Details regarding “means and methods” to accomplish the work (such as excavation equipment and technique selection) are the sole responsibility of the project contractor. The comments contained in this report are based on small diameter borehole observations. The performance of large excavations may differ.

The Occupational Safety and Health Administration (OSHA) Safety and Health Standards (29 CFR Part 1926, Revised October 1989), require that excavations be constructed in accordance with the current OSHA guidelines. Furthermore, the State of Texas requires that detailed plans and specifications meeting OSHA standards be prepared for trench and excavation retention systems used during construction. PSI understands that these regulations are being strictly enforced, and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and Federal safety regulations.

PSI is providing this information solely as a service to the client. PSI does not assume responsibility for construction site safety or the contractor's or other parties’ compliance with local, state, and Federal safety or other regulations. A trench safety plan was outside the scope of this project.

6.0 REPORT LIMITATIONS

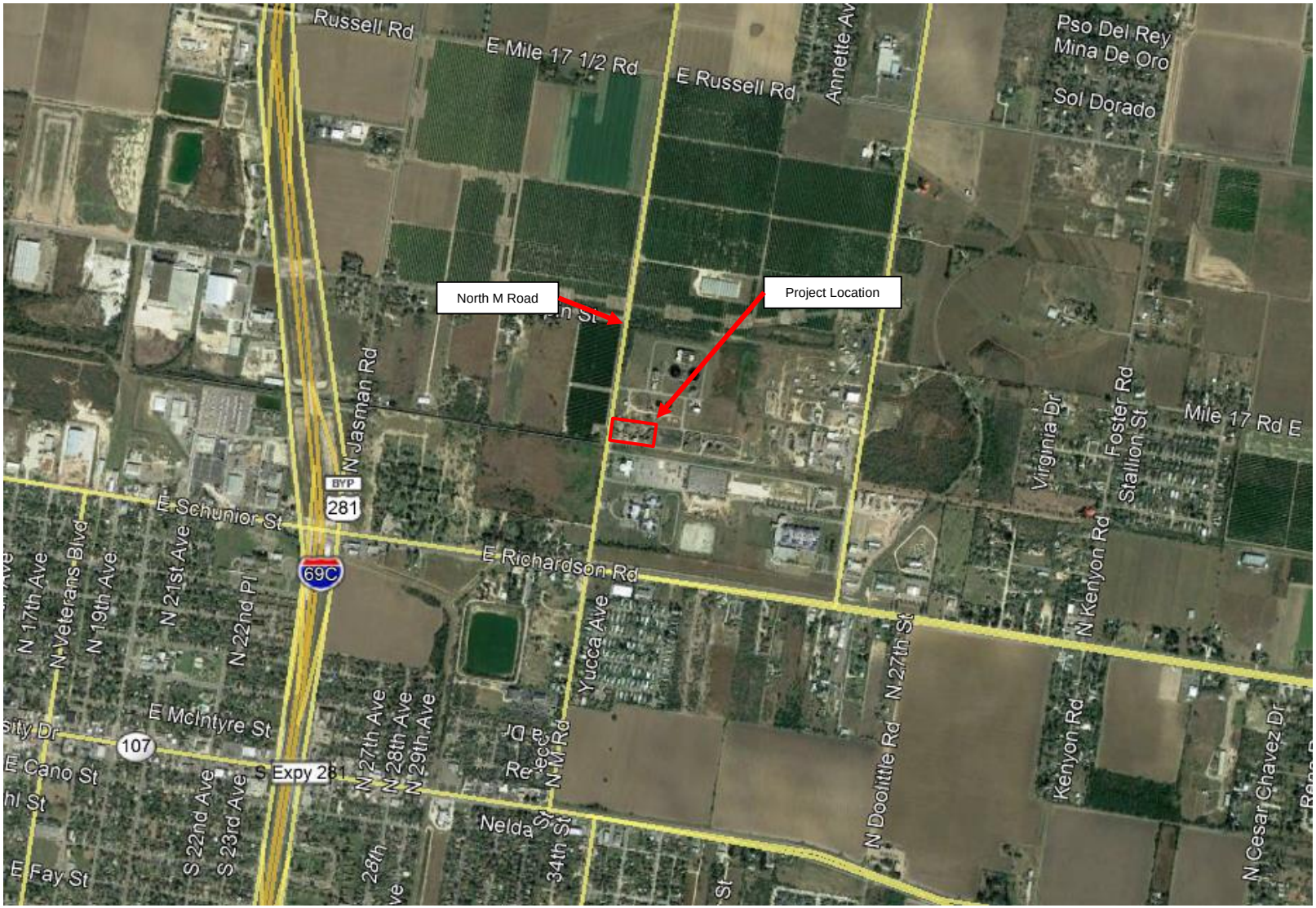
The recommendations submitted in this report are based on the available subsurface information obtained by PSI and design details furnished by the client for the proposed project. If there are any revisions to the plans for this project, or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI should be notified immediately to determine if changes in the foundation recommendations are required. If PSI is not notified of such changes, PSI will not be responsible for the impact of those changes on the project.

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional Geotechnical Engineering practices in the local area. No other warranties are implied or expressed. This report may not be copied without the expressed written permission of PSI.

After the plans and specifications are more complete, the Geotechnical Engineer should be retained and provided the opportunity to review the final design plans and specifications to check that the engineering recommendations have been properly incorporated in the design documents. At this time, it may be necessary to submit supplementary recommendations. If PSI is not retained to perform these functions, PSI will not be responsible for the impact of those conditions on the project.

This report has been prepared for the exclusive use of the City of Edinburg for specific application to the proposed New Wastewater Rehabilitation Office Building to be constructed on North M Road in Edinburg, Texas.

APPENDIX



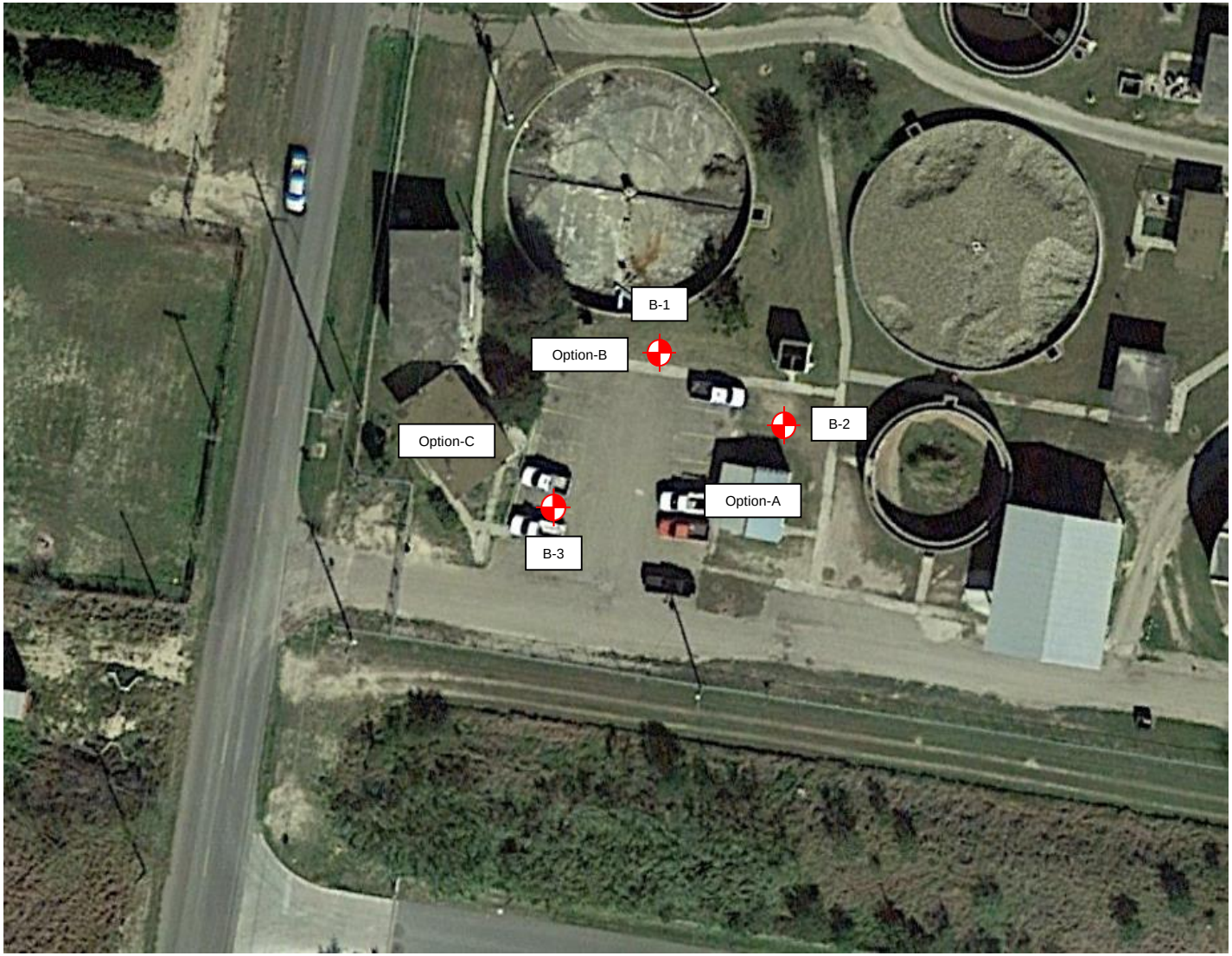
intertek psi
2020 N. Loop 499, Suite 302
Harlingen, Texas 78550
Office - 956.423.6826

Site Vicinity Map

Proposed New Wastewater
Rehabilitation Office Building
North M Road
Edinburg, Texas
PSI Project No.: 03282081

NOT TO SCALE
PLATE 1

N



intertek psi
2020 N. Loop 499, Suite 302
Harlingen, Texas 78550
Office - 956.423.6826

Boring Location Map

Proposed New Wastewater
Rehabilitation Office Building
North M Road
Edinburg, Texas
PSI Project No.: 03282081

NOT TO SCALE
PLATE 2

N

LOG OF BORING NO. B-1

Proposed New Wastewater Rehabilitation Office Building
Edinburg, Texas
PSI Project No.:03282081

TYPE BORING: Continuous Flight Auger LOCATION: 26.3089, -98.1361

DEPTH, FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	% PASSING #200 SIEVE	BLOWS PER FOOT	LIQUID LIMIT	PLASTIC INDEX	MOISTURE CONTENT	SHEAR STRENGTH KSF ○HAND PEN ●UNC 1.0 2.0 3.0 / PL WC LL 20 40 60	UNIT DRY WT. LB./CU FT.
			SURF. ELEV.: apx. 93 ft.							
			Sandy Lean Clay (CL), dark to medium brown, stiff to very stiff, dry to moist	56	10	40	20	8		
					9			13		
5				69	9	39	22	18		
								18		108
			Lean Clay with Sand (CL), medium brown, very stiff, moist	76		48	31	16		
10										
								26		
15										
					20			25		
20										
			Sandy Lean Clay (CL), medium brown, very stiff, moist	53	37			23		
25										
30										

COMPLETION DEPTH: 25.0 FEET DEPTH TO WATER: 18.5 ft
DATE: 3/19/18 DELAYED WATER READING: After Drilling - 15 ft

BL_TEXAS EDINBURG NOB WWTP BL.GPJ PSI_CORP.GDT 5/8/18

PLATE 3

intertek psi
Geotechnical Consulting Services
Harlingen, Texas

LOG OF BORING NO. B-2

Proposed New Wastewater Rehabilitation Office Building
Edinburg, Texas
PSI Project No.:03282081

TYPE BORING: Continuous Flight Auger LOCATION: 26.3088, -98.1361

DEPTH, FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	% PASSING #200 SIEVE	BLOWS PER FOOT	LIQUID LIMIT	PLASTIC INDEX	MOISTURE CONTENT	SHEAR STRENGTH KSF ○HAND PEN ●UNC 1.0 2.0 3.0 PL WC LL 20 40 60	UNIT DRY WT. LB./CU FT.
			SURF. ELEV.: apx. 93 ft.							
			Sandy Lean Clay (CL), dark to medium brown, stiff to firm, moist		10			13		
				68	10	40	24	14		
5								17		
				61		38	22	19		110
								21		
10										
				50		26	17	29		
15										
			Clayey Sand (SC), medium brown, medium dense, moist	39	11			28		
20										
				40	33			23		
25										
30										

COMPLETION DEPTH: 25.0 FEET DEPTH TO WATER: 18 ft
DATE: 3/19/18 DELAYED WATER READING: After Drilling - 15.5 ft

BL_TEXAS EDINBURG NOB WWTP BL.GPJ PSI_CORP.GDT 5/8/18

PLATE 4

intertek psi
Geotechnical Consulting Services
Harlingen, Texas

LOG OF BORING NO. B-3

Proposed New Wastewater Rehabilitation Office Building
Edinburg, Texas
PSI Project No.:03282081

TYPE BORING: Continuous Flight Auger LOCATION: 26.3087, -98.1363

DEPTH, FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	% PASSING #200 SIEVE	BLOWS PER FOOT	LIQUID LIMIT	PLASTIC INDEX	MOISTURE CONTENT	SHEAR STRENGTH KSF ○HAND PEN ●UNC 1.0 2.0 3.0 PL WC LL 20 40 60	UNIT DRY WT. LB./CU FT.
			SURF. ELEV.: apx. 93 ft.							
			1/2 inch of Asphaltic Concrete							
			Sandy Lean Clay (CL), dark to medium brown, very stiff, moist	63	13	34	19	14		
								16	>>○	
5								20		108
			Lean Clay with Sand (CL), medium brown, very stiff, moist	78		38	19	19	>>○	
					24			17		
10										
			Clayey Sand (SC), medium brown, medium dense, moist	48		32	15	23	○	
15										
					9			26		
20										
				35	35			22		
25										
30										

COMPLETION DEPTH: 25.0 FEET DEPTH TO WATER: 18 ft
DATE: 3/19/18 DELAYED WATER READING: After Drilling - 15.5 ft

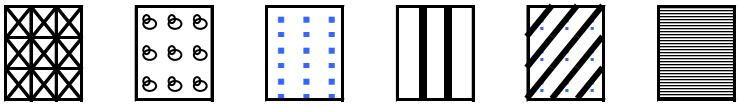
BL_TEXAS EDINBURG NOB WWTP BL.GPJ PSI_CORP.GDT 5/8/18

PLATE 5

intertek psi
Geotechnical Consulting Services
Harlingen, Texas

KEY TO TERMS AND SYMBOLS USED ON LOGS

SOIL TYPE



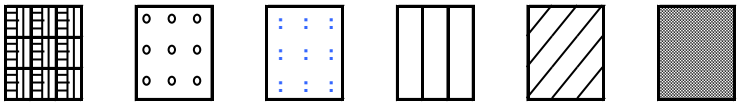
ROCK | GRAVEL | SAND | SILT | CLAY | SHALE

SAMPLER TYPE



NO SAMPLE | AUGER SAMPLE | SHELBY TUBE | SPLIT SPOON

MODIFIERS



STONE | GRAVELY | SANDY | SILTY | CLAYEY | FILL



NO RECOVERY | ROCK CORE | 2" SHELBY TUBE | TXDOT CONE

UNIFIED SOIL CLASSIFICATION SYSTEM - ASTM D 2487

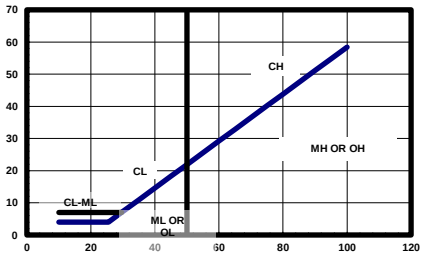
MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS LESS THAN 50% PASSING NO. 4 SIEVE	GRAVEL & GRAVELY SOILS LESS THAN 50% PASSING NO. 4 SIEVE	CLEAN GRAVEL (LITTLE OR NO FINES	GW	WELL GRADED GRAVEL, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY GRADED GRAVEL, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		W/ APPRECIABLE FINES	GM	SILTY GRAVEL, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN 50% PASSING NO. 4 SIEVE	CLEAN SANDS LITTLE FINES	SW	WELL GRADED SAND, GRAVELY SAND (LITTLE FINES)
			SP	POORLY GRADED SANDS, GRAVELY SAND (L.FINES)
		SANDS WITH APPREA. FINES	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS,SAND-CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS & VERY FINE SANDS,ROCK FLOUR SILTY OR CLAYEY FINE SANDS OR CLAYEY SILT W/ LOW PI
			CL	INORGANIC CLAY OF LOW TO MEDIUM PI LEAN CLAY GRAVELY CLAYS, SANDY CLAYS, SILTY CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PI
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY FAT CLAYS
			OH	ORGANIC CLAYS OF MED TO HIGH PI, ORGANIC SILT
HIGHLY ORGANIC SOIL			PT	PEAT AND OTHER HIGHLY ORGANIC SOILS
UNCLASSIFIED FILL MATERIALS			ARTIFICIALLY DEPOSITED AND OTHER UNCLASSIFIED SOILS AND MAN-MADE SOIL MIXTURES	

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	SHEAR STRENGTH IN TONS/FT^2
VERY SOFT	0. TO 0.125
SOFT	0.125 TO 0.25
FIRM	0.25 TO 0.5
STIFF	0.5 TO 1.0
VERY STIFF	1.0 TO 2.0
HARD	> 2.0 OR 2.0+

RELATIVE DENSITY - GRANULAR SOILS

CONSISTENCY	N-VALUE (BLOWS/FOOT)
VERY LOOSE	0-4
LOOSE	4-9
MEDIUM DENSE	10-29
DENSE	30-49
VERY DENSE	> 50 OR 50+



ABBREVIATIONS

HP - HAND PENETROMETER
TV - TORVANE
MV - MINIATURE VANE
UC - UNCONFINED COMPRESSION TEST
UU - UNCONSOLIDATED UNDRAINED TRAIXIAL
CU - CONSOLIDATED UNDRAINED

NOTE: PLOT INDICATES SHEAR STRENGTH AS OBTAINED BY ABOVE TESTS

HYDRO-STATIC WATER LEVEL

WATER LEVEL UNDER HYDRO - STATIC PRESSURE HEAD

CLASSIFICATION OF GRANULAR SOILS

U.S. STANDARD SIEVE SIZE(S)

6"	3"	3/4"	4	10	40	200

BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		
152	76.2	19.1	4.76	2.0	0.42	0.074		0.002

GRAIN SIZE IN MM

Professional Service Industries, Inc.
2020 N. Loop 499, Ste 302
Harlingen, TX 78550
Office - 956.423.6826

June 27, 2018

City of Edinburg
415 W. University Drive
Edinburg, Texas 78541

Attn: Ms. Vanessa Velasquez
Cc: Mr. Andre De Mattos with PBK

Re.: **Geotechnical Engineering Supplemental Recommendations for Subsurface Dry Pit**
Proposed New Wastewater Rehabilitation Office Building
North M Road
Edinburg, Texas
PSI Project No. 03282081-S1

Dear Ms. Velasquez,

Professional Service Industries, Inc. (PSI), an Intertek company, is pleased to submit this supplemental letter report for the refenced project. Please refer to PSI Geotechnical Report No. 03282081, dated May 9, 2018 for recommendations pertaining to this project not addressed herein. These recommendations are provided as an extension of our contract for the original geotechnical report.

It was brought to PSI attention that during the development of the construction documents for the new wastewater office building that a subsurface dry pit was encountered under the existing building that is to be demolished for the development of the new building. It has been conveyed to PSI that the dry pit is a below-grade concrete structure approximately 12 feet wide, 23 feet long and 20 to 25 feet deep and is currently filled with water.

PSI recommends that the dry pit be abandoned in place. After demolition of the existing building, the water should be removed from the dry pit and the concrete cover demolished. The walls of the dry pit should be cut down and then backfilled with a poorly graded gravel to within 3 feet below the finish floor elevation of the new building. A geotextile (Mirafi 140N or similar) should then be placed over the gravel to prevent the select fill from migrating into the gravel. The geotextile should extend at least 3 feet from the edge of the dry pit. From this point, construction of the foundation pad and foundation elements can commence as normal.

Please call with any questions you may have, or if PSI can be of additional service.

Respectfully submitted,
PROFESSIONAL SERVICE INDUSTRIES, INC.
Texas Board of Professional Engineers Certificate of Registration # F003307

Rockford Miller, E.I.T.
Project Manager

Richard E. Webb, P.E.
Principal Consultant



June 27, 2018

DOCUMENT 00 40 00 - COMPETITIVE SEALED PROPOSAL FORM

NEW WASTEWATER TREATMENT PLANT LAB OFFICE BUILDING

Submitted by:_____

Date:_____Phone No.:_____

To: Lorena Fuentes, Purchasing Agent
City of Edinburg
415 West University Drive, c/o City Secretary Department (1st Floor)
Edinburg, TX

Having examined Proposal and Contract Documents prepared by PBK Architects, Inc., dated [June 22, 2018] and having examined site conditions, the undersigned proposes to furnish all labor, equipment and materials and perform all work for the completion of the above-named project for the sum indicated below.

In submitting his Proposal, the undersigned agrees to the following:

1. Hold proposal open for acceptance sixty (60) days after the date on which proposals are opened.
2. Accept right of Owner to reject any or all proposals, to waive formalities and to accept proposal which Owner considers most advantageous.
3. Enter into and execute the contract, if awarded, for the Base Proposal.
4. Complete work in accordance with the Contract Documents within the stipulated contract time.
5. By signing, the undersigned affirms that, to the best of his knowledge, the Proposals have been arrived at independently and is submitted without collusion with anyone to obtain information or gain any favoritism that would in any way limit competition or give an unfair advantage over respondents in the award of this proposal.

I. BASE PROPOSAL AND CONTRACT TIME

Undersigned agrees to complete the Work for the lump sum amount as follows:

A. _____ Dollars$_____
(Amount written in words governs) (Amount in figures)

B. Time of completion: _____ consecutive calendar days.

II. ALTERNATES

A. Alternate No. 1: Asphalt paving, striping, wheel stops and signage: (Add) (Deduct)

_____ Dollars (_____)
(Amount in words) (Amount in figures)

B. Alternate No. 2: Structural concrete roof decking. (Add) (Deduct)

_____ Dollars (_____)
(Amount in words) (Amount in figures)

III. ALLOWANCES

The Undersigned certifies that the allowances in Section 01 21 00 are included in the Base Proposals and agrees that unexpended balance of allowance sums, including the Contractor's markup for the remaining sums, will revert to Owner in the final settlement of the contract.

Owner's Contingency Allowances included in Base Proposal:	**$20,000.00**
Architect's Standard Level of Care Contingency included in Base Proposal:	**$15,000.00**
Irrigation and Landscape Allowance included in Base Proposal:	**$20,000.00**

V. ADDENDA

The Undersigned acknowledges receipt of Addenda No. _____

dated _____, 20__.

The Undersigned acknowledges receipt of Addenda No. _____

dated _____, 20__.

The Undersigned acknowledges receipt of Addenda No. _____

dated _____, 20__.

IV. CHANGES IN THE WORK

The Undersigned understands that changes in the work shall be performed in accordance with the Supplementary Conditions.

It is understood that the right is reserved by the Owner to reject any or all proposals, or waive any informalities in proposal process.

_____
Authorized Signature

_____
Title

(Seal, if a Corporation)
State whether Corporation,
Partnership or Individual

_____
Name of Contracting Firm

_____
Address

_____
Telephone

_____
Date

END OF DOCUMENT 00 40 00

DOCUMENT 00 40 01 - PROPOSAL BOND

KNOW ALL MEN BY THESE PRESENTS, that we _____, as Principal, and _____, as Surety, are held and firmly bound unto City of Edinburg, hereinafter called the Owner, in the penal sum of _____Dollars ($_____) lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Principal has submitted the accompanying Proposal, dated _____, 20___, for New Wastewater Treatment Plant Lab Office Building, the kind and extent of work involved being set forth in detail in the proposed Contract Documents cited herein.

THEREFORE, if the Principal shall not withdraw the accompanying proposal within sixty (60) days after the date set for opening thereof, and shall within ten days after the prescribed forms are presented for signature, enter into a written contract with the Owner in accordance with the Proposal as accepted; and give Bond and good and sufficient surety for the faithful performance and proper fulfillment of the contract including payment of persons supplying labor or materials therefor, or in the event of the withdrawal of the proposal within the period specified, or the failure to enter into a contract and give the bond within the time specified, if the Principal shall pay to the Owner the difference between the aggregate amount for which the Owner may enter into a contract for the same work with another Respondent; if the latter amount be in excess of the former, then the above obligation shall be void and of no effect, otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above bonded parties have executed this instrument under their respective seals this _____ day of _____, 20___, the name and Corporate Seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representatives, pursuant to authority of its governing body.

_____ _____
Business Address Individual Principal

_____ _____
Business Address Individual Principal

ATTEST:

_____ BY:_____
Secretary President

_____ _____
Business Address Corporate Surety

ATTEST:_____ BY:_____

END OF DOCUMENT 00 40 01

NOTE: THIS DOCUMENT MUST BE SUBMITTED WITH PROPOSAL

DOCUMENT 00 40 12 - LIST OF SUBCONTRACTORS

Project:
New Wastewater Treatment Plant
Lab Office Building
City of Edinburg

Architect:
PBK Architects
3900 North 10th Street, Suite 810
McAllen, Texas 78501

Architect's Project No. 1811

Contractor:
_____

_____

_____

Date: _____

List Subcontractors and others proposed to be employed on the Project required by the proposal documents.
(To be completed by the Contractor and returned to the Architect.)

Work/ Division	Firm	Address	Phone/Fax	Email	Representative

(Provide additional sheets as required.)

END OF DOCUMENT 00 40 12

NOTE: THIS DOCUMENT MUST BE SUBMITTED WITH PROPOSAL FORM

DOCUMENT 00 40 13 - AFFIDAVIT OF NON-DISCRIMINATORY EMPLOYMENT

STATE OF TEXAS)
)
COUNTY OF _____)

AFFIDAVIT

This Company, Contractor, or Subcontractor agrees to refrain from discrimination in terms and conditions of employment to the basis of race, color, religion, sex, or national origin, and agrees to take affirmative action as required by Federal Statutes and rules and Regulations issued pursuant thereto in order to maintain and insure non-discriminatory employment practices.

_____
Company

_____
Printed Name

_____
Signature

STATE OF TEXAS)
)
COUNTY OF _____)

Sworn to and subscribed before me at _____, Texas, this the _____ day of _____, 20__.

_____
Notary Public in and for _____ County, Texas

END OF DOCUMENT 00 40 13

NOTE: THIS DOCUMENT MUST BE SUBMITTED WITH PROPOSAL

DOCUMENT 00 40 14 - AFFIDAVIT OF NONASBESTOS, LEAD, AND PCB USE IN PROJECT

Upon completion of this form, return to the Architect at Project Closeout.

Project:
New Wastewater Treatment Plant
Lab Office Building
City of Edinburg

Architect:
PBK Architects
3900 North 10th Street, Suite 810
McAllen, Texas 78501

Architect's Project No. 1811

Contractor: _____ Date: _____

(Name, address) _____

_____

AFFIDAVIT

The undersigned affirms and certifies that "to the best of their knowledge and belief asbestos, lead, and PCB containing materials have not been used or incorporated into the Work and lead or lead bearing materials have not been incorporated into potable water systems", including, but not limited to those water systems for drinking fountains, all sinks, showers, bath tubs, residential and commercial kitchen equipment, ice machines, and hose bibbs, as applicable to the project, and that lead sheet flashing used in through roof plumbing penetration applications is the only lead on the Project.

_____
Company

_____
Printed Name

_____
Signature

STATE OF TEXAS)
)
COUNTY OF _____)

Sworn to and subscribed before me at _____, Texas, this the _____ day of _____, 2018.

_____
Notary Public in and for _____ County, Texas

END OF DOCUMENT 00 40 14

DOCUMENT 00 40 17 - CERTIFICATION OF CRIMINAL HISTORY RECORD INFORMATION REVIEW BY CONTRACTOR-EMPLOYER

Certifying Affidavit submitted to:

Name of Owner: _____

Mailing Address: _____

_____

Project: _____

_____

STATE OF TEXAS §

COUNTY OF HIDALGO §

(I) The undersigned representative, on behalf of the contracting firm identified below, swears and affirms to City of Edinburg (the "Owner") that such firm has obtained, reviewed and verified, from a law enforcement or criminal justice agency or a private entity that is consumer reporting agency governed by the Fair Credit Reporting Act (15 U.S.C. §§ 1681 et seq.) the criminal history record information of employees prior to 1 January 2008**,** who (a) have or will have continuing duties related to the contracted services, and (b) have or will have direct contact with students. Such employees are identified by name on Schedule A (contractor shall provide and attach hereto). The undersigned further swears and affirms no employees who meet the requirements of (a) and (b) herein and/or identified on Schedule A have been convicted of any offense identified in Section 22.085 of the Texas Education Code.

(2) The undersigned representative, on behalf of the contracting firm identified below, swears and affirms to the Owner, that such firm has obtained, reviewed and verified, from the Texas Department of Public Safety criminal clearinghouse, the national criminal history record information of all employees hired on or after 1 January 2008**,** who (a) have or will have continuing duties related to the contracted services, and (b) have or will have direct contact with students. Such employees are identified by name on Schedule B (contractor shall provide and attach hereto). The undersigned further swears and affirms no employees who meet the requirements of (a) and (b) herein and/or identified on Schedule B have been convicted of any offense identified in Section 22.085 of the Texas Education Code.

(3) The undersigned firm swears and covenants that no present or future employee will provide services to the Project that involve direct contact with students unless and until such employee's national criminal history record information has been reviewed and cleared as required by Paragraph (2) above, and an updated Certification has submitted by the contracting firm to the Owner with an updated Schedule B identifying such employees. In the event of an emergency, an employee who has not been previously certified may only provide services that involve direct contact with students if such employee is escorted by a Owner representative.

(4) The undersigned firm swears and covenants that, upon receipt of information, directly or indirectly, that any employee of the contracting firm has been convicted of an offense identified in Section 22.085 of the Texas Education Code, the contracting firm will immediately remove such employee from the Project and notify the Owner.

(5) Furthermore, if requested by the Owner, the name, driver's license number, and any other information required by the DPS will be submitted to the Owner for any person on either Schedule A or Schedule B.

_____, being duly sworn, affirms and certifies that he/she is the

_____ (position) of _____(contracting firm),

and that all statements and acknowledgements contained herein are true and correct, and that he/she has the authority to bind such firm to the covenants set out above.

_____

Subscribed and sworn to before me this _____ day of _____

Notary Public _____ State of _____

My Commission expires _____

END OF DOCUMENT 00 40 17

DOCUMNENT 00 40 19 - PROPOSAL EVALUATION WAIVER

By submitting a Proposal, the proposer indicated below agrees to waive any claim it has or may have against the Owner, Architect, Engineers, Consultants and their respective employees, arising out of or in connection with the administration, evaluation, or recommendation of any proposal. The proposer further agrees the Owner reserves the right to waive any requirements under the proposal documents or the Contract Documents, with regards to acceptance or rejection of any proposals, and recommendation or award of the contract.

NOTE: The Statement of Affirmation Must Be Notarized.

STATEMENT OF AFFIRMATION

"The undersigned affirms that he/she is duly authorized to execute this waiver by the person(s) or business entity making the proposal.

Firm's Name_____ Address: _____

_____

Proposer's
Name_____ Position/Title _____

Proposer's
Signature_____ Date _____

Subscribed and sworn to me on this _____day of _____

Notary Public

My Commission expires_____

END OF DOCUMENT 00 40 19

DOCUMENT 00 40 20 - CERTIFICATE OF INTERESTED PARTIES

CERTIFICATE OF INTERESTED PARTIES – FORM 1295

Certificate of Interested Parties (Form 1295): Electronically complete and submit using the Texas Ethics Commission's online filing application. Print a copy of Form 1295, sign, have notarized, and, with a copy of the Certificate of Filing.

City of Edinburg is required to comply with House Bill 1295, which amends the Texas Government Code by adding Section 2252.908, Disclosure of Interested Parties. Section 2252.908 prohibits the City of Edinburg from entering into a contract resulting from a Competitive Bid with a business entity unless the business entity submits a Disclosure of Interested Parties (Form 1295) City of Edinburg at the time business entity submits the signed contract. The Texas Ethics Commission has adopted rules requiring the business entity to file Form 1295 electronically with the Texas Ethics Commission.

Definitions:

1. Interested Party: A person:
   a) who has a controlling interest in a business entity with whom the City of Edinburg contracts; or
   b) who actively participates in facilitating the contract or negotiating the terms of the contract, including a broker, intermediary, adviser, or attorney for the business entity.
2. Business Entity: An entity recognized by law through which business is conducted, including a sole proprietorship, partnership, or corporation.

As a business entity, each vendors must electronically complete, print, sign, notarize, and submit Form 1295 and the Certification of Filing with their proposals even if no interested parties exist.

File Form 1295 with the Texas Ethics Commission (TEC) using the online filing application, which can be found at https://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm. Proposers must use the filing application on the Texas Ethics Commission's website to enter the required information on Form 1295. Proposers must print a copy of the completed form, which includes a certification of filing containing a unique certification number. Form 1295 shall be signed by an authorized agent of the business entity and notarized.

Submit the completed Form 1295 with the certification of filing with the City of Edinburg by attaching the completed form to the vendor's solicitation response.

The City of Edinburg must acknowledge the receipt of the filed Form 1295 by notifying the Texas Ethics Commission of the receipt of the filed Form 1295 no later than the 30th day after the date the contract binds the parties to the contract. After the City of Edinburg acknowledges the Form 1295, the Texas Ethics Commission will post the completed Form 1295 to its website within seven business days after receiving notice from the City of Edinburg.

SAMPLE FORM 1295

CERTIFICATE OF INTERESTED PARTIES — FORM 1295

Complete Nos. 1 - 4 and 6 if there are interested parties.
Complete Nos. 1, 2, 3, 5, and 6 if there are no interested parties.

OFFICE USE ONLY

1 **Name of business entity filing form, and the city, state and country of the business entity's place of business.**

2 **Name of governmental entity or state agency that is a party to the contract for which the form is being filed.**

3 **Provide the identification number used by the governmental entity or state agency to track or identify the contract, and provide a description of the goods or services to be provided under the contract.**

4 Name of Interested Party	City, State, Country (place of business)	Nature of Interest (check applicable)	
		Controlling	Intermediary

5 **Check only if there is NO Interested Party.** ☐

6 **AFFIDAVIT**

I swear, or affirm, under penalty of perjury, that the above disclosure is true and correct.

_____
Signature of authorized agent of contracting business entity

AFFIX NOTARY STAMP / SEAL ABOVE

Sworn to and subscribed before me, by the said _____, this the _____ day of _____, 20 _____, to certify which, witness my hand and seal of office.

_____ _____ _____
Signature of officer administering oath | Printed name of officer administering oath | Title of officer administering oath

ADD ADDITIONAL PAGES AS NECESSARY

Form provided by Texas Ethics Commission www.ethics.state.tx.us Adopted 10/5/2015

END OF DOCUMENT 00 40 20

DOCUMENT 00 45 00 - SELECTION CRITERIA AND CONTRACTOR INFORMATION SHEET

Proposals are to include the information requested in this of this Request in the sequence and format prescribed. In addition to and separate from the requested information, offerors submitting proposals may provide supplementary materials further describing their capabilities and experience.

Following the deadline for receipt, the Owner's staff will receive, publicly open, and read aloud the names of the offerors and, if any are required to be stated, all prices stated in the proposals. The Owner's staff will recommend that the City Commission select a construction contractor from the respondents to this Request for Competitive Bids or reject all proposals.

The recommendation shall be based on the data furnished by the offerors in response to the Request for Competitive Bids.

All responses in the proposal may be used to help the Owner select a contractor. The Owner reserves the right to verify the accuracy and completeness of all responses by utilizing any information available to the Owner without regard to whether such information appears in the proposal.

Please provide the following information concerning your firm:

A. Offeror Information

1. Name of firm
2. Business address
3. Telephone number
4. Fax number
5. Type of organization (individual, partnership, corporation, association).
6. Number of permanent employees. (Employees hired for the duration of a specific project or under a fixed-term contract are not considered permanent employees for purposes of this proposal).
   i. Home office
   ii. Field
7. Primary contact person for Owner inquiries.
8. Main office location (if different than above).

B. Personnel Information

Provide brief resumes (two page limit) for the individuals listed below:

1. Principals/ Corporate Officers:
   i. President
   ii. Vice President
   iii. Partners
2. Project Management Candidates
   i. Project Manager
   ii. Superintendent

For the Project Manager and Superintendent candidates, please list up to two (2) people you consider qualified for each position. Please also provide a list of the principal duties and responsibilities you anticipate assigning to the Project Manager and to the Superintendent.

C. Municipal Projects

List all Municipal projects your firm has completed within the past five (5) years, and for each project list the following information:

1. Project owner
2. Brief description of the project
3. Client, client contact person, and telephone number
4. Date construction completed
5. Managing Principal
6. Project Architect or Engineer

For the ten (10) largest projects please also provide the following information:

7. Original contract amount
8. Final contract amount
9. Number of change orders

D. Non-Municipal Projects (Optional)

List up to five (5) major non-municipal building projects your firm has completed within the past five years, and for each project list:.

1. Name and location of the project
2. Brief description of the project
3. Client, client contact, and telephone number
4. Final contract amount
5. Date construction completed
6. Managing Principal
7. Project Architect or Engineer

E. Claims and Litigation

1. Identify any claims or suits, if any, brought against your firm within the last five (5) years.
2. Describe all instances in which your firm was unable to complete the work under a contract.
3. Identify any judgments, claims arbitration proceedings or suits pending or outstanding against your firm or its officers.
4. Identify any lawsuits filed or arbitration requested by your firm with respect to construction contracts of your firm.

F. Current Work Load

Provide the following information for the five (5) largest projects you currently have under contract:

1. Project name
2. Location
3. Owner
4. Architect
5. Current contract amount
6. Percent complete
7. Specified contract completion date

G. Financial Information

Provide the following financial information regarding your firm:

1. Total amount of work performed as general contractor for each of the past five (5) years.
2. Bonding capacity
   i. Per project
   ii. Aggregate
3. Bank reference(s)
   i. Individual, title
   ii. Name of bank
   iii. Address
   iv. Telephone
4. Bonding company reference(s).
   i. Individual, title
   ii. Name of bonding company
   iii. Address
   iv. Telephone
5. Dunn & Bradstreet rating, if available

H. Safety Record

Describe your organization's safety program and provide your worker's compensation experience modification factor. List any safety awards your organization has received within the past five (5) years.

I. Execution

The foregoing is true and correct. The Owner, or any authorized representative of the Owner, is authorized by the undersigned to contact any firm, institution, or person listed above to obtain information about our firm's services, financial condition, and any other information which the Owner might determine as being desirable.

Offeror: _____

By: _____
(Signature)

_____
(Printed Name)

_____
(Title)

END OF DOCUMENT 00 45 00

DOCUMENT 00 50 00 - TEXAS STATUTORY PERFORMANCE BOND
Bond No.: _____

(Penalty of this bond must be 100% of contract amount)

KNOW ALL MEN BY THESE PRESENTS, that: _____
(hereinafter called the Principal), as principal, and _____
a corporation organized and existing under the laws of the State of _____
authorized and admitted to do business in the State of Texas and licensed by the State of Texas to execute bonds as Surety (hereinafter called the Surety), as Surety, are held and firmly bound unto

_____

_____

(hereinafter called the Obligee) in the amount of _____

_____

Dollars($_____) for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the_____ day of _____ , 20__, for

Name of Offeror (General Contractor)
New Wastewater Treatment Plant Lab Office Building
City of Edinburg
Attn: Loren Fuentes, Purchasing Agent

which contract is hereby referred to and made a part hereof as fully and the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall faithfully perform the work in accordance with the plans, specifications and contract documents, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Chapter 22.53 of the Texas Government Code and all liabilities on this bond shall be determined in accordance with the provisions of said Chapter to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this Instrument this _____day of _____ , 20__.

(Seal)
_____

_____
Principal

_____
Surety Address

By:_____

_____

(Seal)
_____
Surety Telephone Number

Surety

By: _____
Attorney-in-Fact

END OF DOCUMENT 00 50 00

DOCUMENT 00 50 01 - TEXAS STATUTORY PAYMENT BOND

BOND NO.: _____

(Penalty of this bond must be 100% of contract amount)

KNOW ALL MEN BY THESE PRESENTS, that: _____
(hereinafter called the Principal), as principal, and_____
a corporation organized and existing under the laws of the State of _____ authorized and admitted to do business in the State of Texas and licensed by the State of Texas to execute bonds as Surety (hereinafter called the Surety), as Surety, are held and firmly bound unto

_____

_____

(hereinafter called the Obligee) in the amount of _____

_____

Dollars($_____) for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the_____ day of _____ , 20__, for

Name of Offeror (General Contractor)
New Wastewater Treatment Plant Lab Office Building
City of Edinburg
Attn: Lorena Fuentes, Purchasing Agent

which contract is hereby referred to and made a part hereof as fully and the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall pay all claimants supplying labor and material to him or a Subcontractor in the prosecution of the work provided for in said contract, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, that the bond is executed pursuant to the provisions of Chapter 22.53 of the Texas Government Code and liabilities on this bond to claimants shall be determined in accordance with the provisions of said Chapter to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this Instrument this _____day of _____ , 20__.

_____(Seal)
Witness: Principal

_____ By: _____

Witness: _____ (Seal)
Surety

_____ By: _____
Attorney-in-Fact

_____

_____ _____

Surety Address

Surety Telephone Number

END OF DOCUMENT 00 50 01

DOCUMENT 00 65 01 - PROPOSAL EVALUATION WAIVER

By submitting a Proposal, the proposer indicated below agrees to waive any claim it has or may have against the Owner, Architect, Engineers, Consultants and their respective employees, arising out of or in connection with the administration, evaluation, or recommendation of any proposal. The proposer further agrees the Owner reserves the right to waive any requirements under the proposal documents or the Contract Documents, with regards to acceptance or rejection of any proposals, and recommendation or award of the contract.

NOTE: The Statement of Affirmation Must Be Notarized.

STATEMENT OF AFFIRMATION

"The undersigned affirms that he/she is duly authorized to execute this waiver by the person(s) or business entity making the proposal.

Firm's Name_____ Address: _____

_____

Proposer's
Name_____ Position/Title _____

Proposer's
Signature_____ Date _____

Subscribed and sworn to me on this _____day of _____

Notary Public

My Commission expires_____

END OF DOCUMENT 00 65 01

DOCUMENT 00 65 10 - WAIVER AND RELEASE OF LIEN FORM

WAIVER AND RELEASE OF LIEN UPON PROGRESS PAYMENT

The undersigned lienor, hereby waives and releases its lien and right to claim a lien for labor, services, or materials furnished through _____ (insert date) to _____ (Contractor)

on the project of the New Wastewater Treatment Plant Lab Office Building and PBK Project Number 1811 for the City of Edinburg.

This waiver and release does not cover any retention or labor, services, or materials furnished after the date specified.

DATED on _____, 20___.

By: _____ (Lienor)

Subscribed and sworn to me on this _____ day of _____, 20___.

_____
Notary Public

My Commission expires _____

WAIVER AND RELEASE OF LIEN UPON FINAL PAYMENT

The undersigned lienor, hereby waives and releases its lien and right to claim a lien for labor, services, or materials furnished through _____ (insert date) to _____ (Contractor)

on the project of the New Wastewater Treatment Plant Lab Office Building and PBK Project Number 1811 for the City of Edinburg.

DATED on _____, 20___.

By: _____ (Lienor)

Subscribed and sworn to me on this _____ day of _____, 20___.

_____
Notary Public

My Commission expires _____

End of Document

DOCUMENT 00 70 00 - CONTRACT DOCUMENTS

I. CONSTRUCTION CONTRACT AGREEMENT

A. The contract for the construction of the project shall be executed by the successful Offeror on the 2017 Edition of AIA Document A101 *Standard Form of Agreement between Owner and Contractor"* as modified by the Owner. Said contract, fully executed, shall be delivered to the Owner within ten (10) days of receipt of said contract.

II. CONDITIONS OF THE CONTRACT

A. AIA Document A201 *The General Conditions of the Contract for Construction* 2017 Edition, modified by Owner is made a part of the Contract Documents.

B. Failure to obtain and examine the documents does not relieve the Contractor, Subcontractors, Sub-subcontractors, and material suppliers of responsibilities incorporated into the Agreement.

END OF DOCUMENT 00 70 00

DRAFT

AIA® Document A101™ – 2017

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

AGREEMENT made as of the « » day of « » in the year « »
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

«City of Edinburg -»« »
«415 W. University Dr. -»
«Edinburg, Texas 78540- »
«Phone: (956) 388-8207 »

and the Contractor:
(Name, legal status, address and other information)

« »« »
« »
« »
« »

for the following Project:
(Name, location and detailed description)

«City of Edinburg - New Waste Water Treatment Plant Office Bldg.»
«»
«»

The Architect:
(Name, legal status, address and other information)

«-PBK Architects, Inc. -»« »
«3900 N. 10th St., Ste. 810- »
«McAllen, Texas 78501- »
«Phone: (956) 687-1330- »

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

The parties should complete A101™–2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201™–2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

ELECTRONIC COPYING of any portion of this AIA® Document to another electronic file is prohibited and constitutes a violation of copyright laws as set forth in the footer of this document.

AIA Document A101™ – 2017. Copyright © 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1967, 1974, 1977, 1987, 1991, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved. WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law.** This draft was produced by AIA software at 11:28:14 on 06/25/2018 under Order No.0878111995 which expires on 01/25/2019, and is not for resale.
User Notes: (1196249941)

TABLE OF ARTICLES

1 THE CONTRACT DOCUMENTS

2 THE WORK OF THIS CONTRACT

3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

4 CONTRACT SUM

5 PAYMENTS

6 DISPUTE RESOLUTION

7 TERMINATION OR SUSPENSION

8 MISCELLANEOUS PROVISIONS

9 ENUMERATION OF CONTRACT DOCUMENTS

EXHIBIT A INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:
(Check one of the following boxes.)

[« »] The date of this Agreement.

[« »] A date set forth in a notice to proceed issued by the Owner.

[« X »] Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

«Commencement Date as indicated in the Notice to Proceed (NTP)- »

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

§ 3.2 The Contract Time shall be measured from the date of commencement of the Work.

§ 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:
(Check one of the following boxes and complete the necessary information.)

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User Notes: (1196249941)

[« »] Not later than « » (« ») calendar days from the date of commencement of the Work.

[« »] By the following date: « »

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

Portion of Work	Substantial Completion Date

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be « » ($ « »), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

Item	Price

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.
(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance

§ 4.3 Allowances, if any, included in the Contract Sum:
(Identify each allowance.)

Item	Price
Owner's Contingency Allowance	$20,000.00
Architect Standard Level of Care	$15,000.00
Irrigation and Landscaping Allowance	$20,000.00

§ 4.4 Unit prices, if any:
(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price per Unit ($0.00)

§ 4.5 Liquidated damages, if any:
(Insert terms and conditions for liquidated damages, if any.)

«Owner may deduct from the final payment made to the Contractor a sum equal to $500.00 per calendar day for each calendar day beyond the agreed date which the Contractor shall require for Substantial Completion of the work included in this contract. It is expressly understood that the said sum per day is agreed upon as a fair estimate of the pecuniary damages which will be sustained by the Owner in the event that the work is not completed within the contract time. The sum shall be considered as liquidated damages only and in no sense shall be considered a penalty. Failure to complete and close out project 60 days after Substantial Completion will result in liquidated damages being assessed in the amount of $250.00 per calendar day until close-out occurs.- »

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User Notes: (1196249941)

§ 4.6 Other:
(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)

« »

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

« »

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the « 25th » day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the « 30th » day of the « following » month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than « thirty-five » (« 35 ») days after the Architect receives the Application for Payment.
(Federal, state or local laws may require payment within a certain period of time.)

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Architect may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 In accordance with AIA Document A201™–2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.1 The amount of each progress payment shall first include:

.1 That portion of the Contract Sum properly allocable to completed Work;

.2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and

.3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

.1 The aggregate of any amounts previously paid by the Owner;

.2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017;

.3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;

.4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2017; and

.5 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:

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(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)

« »

§ 5.1.7.1.1 The following items are not subject to retainage:
(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

« »

§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:
(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)

« »

§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:
(Insert any other conditions for release of retainage upon Substantial Completion.)

« »

§ 5.1.8 If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.

§ 5.1.9 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 Final Payment

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

.1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and

.2 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment, or as follows:

« »

§ 5.3 Interest

Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.
(Insert rate of interest agreed upon, if any.)

«0- » % «Zero- »

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.
(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

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« »
« »
« »
« »

§ 6.2 Binding Dispute Resolution

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows:
(Check the appropriate box.)

[« »] Arbitration pursuant to Section 15.4 of AIA Document A201–2017

[« »] Litigation in a court of competent jurisdiction

[« »] Other *(Specify)*

« »

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017.

§ 7.1.1 If the Contract is terminated for the Owner's convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows:
(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner's convenience.)

« »

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 The Owner's representative:
(Name, address, email address, and other information)

«Richard M. Hinojosa- »
«City Manager- »
«City of Edinburg- »
«415 W. University Dr.- »
«Edinburg, Texas 78540- »
«Phone: (956) 388-8207 »

§ 8.3 The Contractor's representative:
(Name, address, email address, and other information)

« »
« »
« »
« »

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« »
« »

§ 8.4 Neither the Owner's nor the Contractor's representative shall be changed without ten days' prior notice to the other party.

§ 8.5 Insurance and Bonds

§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A101™–2017 Exhibit A, and elsewhere in the Contract Documents.

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:
(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

« »

§ 8.7 Other provisions:

« »

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

.1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor

.2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds

.3 AIA Document A201™–2017, General Conditions of the Contract for Construction

.4 AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:
(Insert the date of the E203-2013 incorporated into this Agreement.)

« »

.5 Drawings

Number	Title	Date

.6 Specifications

Section	Title	Date	Pages

.7 Addenda, if any:

Number	Date	Pages

Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are also enumerated in this Article 9.

.8 Other Exhibits:

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(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

[« »] AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:
(Insert the date of the E204-2017 incorporated into this Agreement.)

« »

[« »] The Sustainability Plan:

Title	Date	Pages

[« »] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

.9 Other documents, if any, listed below:
(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™–2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)

« »

This Agreement entered into as of the day and year first written above.

OWNER *(Signature)*	CONTRACTOR *(Signature)*
«Richard M. Hinojosa, City Manager- »« »	« »« »
(Printed name and title)	*(Printed name and title)*

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AIA® Document A201™ – 2017

General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)

«City of Edinburg - New Waste Water Treatment Plant Office Bldg.»
«»

THE OWNER:
(Name, legal status and address)

«City of Edinburg
415 W. University Dr.
Edinburg, Texas 78540- »« »
« »

THE ARCHITECT:
(Name, legal status and address)

«PBK Architects, Inc.
3900 N. 10th St., Ste. 810
McAllen, Texas 78501- »« »
« »

TABLE OF ARTICLES

1 GENERAL PROVISIONS

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13 MISCELLANEOUS PROVISIONS

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.

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14 TERMINATION OR SUSPENSION OF THE CONTRACT

15 CLAIMS AND DISPUTES

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

§ 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 The Work

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

§ 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

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§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or

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relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

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§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as

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the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

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§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

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§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

.1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;

.2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and

.3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and

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similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will

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specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

§ 3.13 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

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§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

ARTICLE 4 ARCHITECT

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

§ 4.2 Administration of the Contract

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

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§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in

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number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

.1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and

.2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

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When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

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§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

.1 The change in the Work;
.2 The amount of the adjustment, if any, in the Contract Sum; and
.3 The extent of the adjustment, if any, in the Contract Time.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

.1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
.2 Unit prices stated in the Contract Documents or subsequently agreed upon;
.3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
.4 As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

.1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;

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.2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;

.3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;

.4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and

.5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

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§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

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§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

.1 defective Work not remedied;
.2 third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
.3 failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
.4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
.5 damage to the Owner or a Separate Contractor;
.6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or

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.7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

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§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

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§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

.1 liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
.2 failure of the Work to comply with the requirements of the Contract Documents;
.3 terms of special warranties required by the Contract Documents; or
.4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

.1 employees on the Work and other persons who may be affected thereby;

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.2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and

.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed

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by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 11.1.3 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the

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procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

§ 11.3 Waivers of Subrogation

§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

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The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

§11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

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§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect

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timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

.1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;

.2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;

.3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or

.4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract

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Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

.1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;

.2 fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;

.3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or

.4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

.1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

.2 Accept assignment of subcontracts pursuant to Section 5.4; and

.3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

.1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or

.2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

.1 cease operations as directed by the Owner in the notice;

.2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and

.3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work

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properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

§ 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

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.1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

.2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

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§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party

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provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.

DRAFT

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SECTION 01035

CIVIL ENGINEERING REQUESTS FOR INFORMATION

PART I GENERAL

1.01 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for handling and processing "Requests for Information" (RFI).

2. "Request for Information" process diagram is attached at the end of this Section.

3. "Request for Information" form is attached at the end of this Section.

1.02 DEFINITION

A. Requests for Information: A formal process used during the construction phase to facilitate communication between the contractor and the Civil Engineering consultant with regard to requests for additional information and clarification of the intent of the Contract Documents (Drawings and Specifications) .

B. Do not use "Request for Information" form during bidding. Direct questions during bidding phase as indicated in the bid documents.

1.03 PROCEDURE

A. Conditions Requiring Clarification of the Contract Documents:

1. Contractor shall submit a "Request for Information" to the civil Engineering Consultant.

2. Submit "Requests for Information" from Contractor's office or field office only. "Requests for Information" submitted directly from subcontractors or suppliers will not be accepted.

3. Generate "Requests for Information" by one source per project and number accordingly.

4. Submit one "Request for Information" per form.

B. Civil Engineering Consultant will review RFI from the Contractor with reasonable promptness and the Contractor will be notified in writing of decisions made.

1. The Civil Engineering Consultant's written response to the RFI shall <u>not</u> be considered as a Change Order or Change Directive, nor does it authorize changes in the Contract Sum or Contract Time.

C. Contractor shall maintain a log of "Requests for Information" sent to, and responses from Civil Engineering Consultant. "Requests for Information" log shall be sent, by Fax, every Friday to the Civil Engineering Consultant.

D. All "Requests for Information" regarding scheduling, costing and owner provided equipment coordination shall be directed to the owner's Construction Manager.

1.04 REQUEST FOR INFORMATION FORM

A. Submit "Requests for Information" on the attached "Request for Information" form, or format accordingly on letterhead. Civil Engineering Consultant will not respond to requests for information unless this form or format is utilized.

B. Where submittal form or format does not provide space needed for complete information, additional sheets may be attached.

END OF SECTION 01035

CIVIL ENGINEERING REQUEST FOR INFORMATION

RFI NO. _____

DATE: _____ PROJECT _____
(CITY, STATE)

TO: _____
(CIVIL ENGINEERING CONSULTANT)

FROM: _____ DRAWING NO. _____
(GENERAL CONTRACTOR)

DETAIL NO. _____

_____
(PROJECT SUPERINTENDENT) SPECS SECTION NO. _____

_____
(JOB SITE FAX NUMBER)

RFI Type:

( )	Demolition	( )	Rock	( )	utilities	( )	Site Lighting
( )	Site Preparation	( )	Erosion Control	( )	Paving	( )	Slope Stabilization/ Retaining Walls
( )	Earthwork	( )	Storm Sewer	( )	Landscape/ Irrigation	( )	Traffic Related
						( )	Other

Information Requested:

_____
_____
_____
_____
_____
_____
_____

Requested By: _____

Reply:

_____
_____
_____
_____
_____

_____ _____
Response By: Date:

File Distribution:

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Project information.
   2. Work covered by Contract Documents.
   3. Phased construction.
   4. Work by Owner.
   5. Work under separate contracts.
   6. Future Work.
   7. Purchase contracts.
   8. Owner furnished products.
   9. Owner furnished, Contractor installed products.
   10. Access to site.
   11. Coordination with occupants.
   12. Work restrictions.
   13. Specification and drawing conventions.
   14. Construction Schedule

1.3 PROJECT INFORMATION

A. Project Identification: Waste Water Treatment Plant Office
   1. Project Location: North M Rd. Edinburg, Texas 78541

B. Owner: City of Edinburg
   1. Owner's Representative: Lorena Fuentes, Financing Department

C. Architect: PBK Architects, McAllen, Texas.

D. Consultants: Additional design professionals have been retained who have prepared designated portions of the Contract Documents.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents.

B. Type of Contract: Project will be constructed under a Competitive Bids (CB) contract.

1.5 WORK BY OWNER AND UNDER SEPARATE CONTRACTS

A. Cooperate fully with Owner so Work may be carried out smoothly, without interfering with or delaying the work or work by Owner. Coordinate the Work with Work performed by Owner.

B. The Owner reserves the right to let separate contract for Work outside of the scope of this Contract. Cooperate fully with separate contractors so Work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with Work performed under separate contracts.

C. Purchase Contracts: The Owner reserves the right to negotiate purchase contracts with suppliers of material and equipment that may be incorporated into the Work. The Owner will assign these purchase contracts to Contractor. Include costs for purchasing, receiving, handling, storage if required, and installation of material and equipment in the Contract Sum, unless otherwise indicated.
   1. Contractor's responsibilities are same as if Contractor had negotiated purchase contracts, including responsibility to renegotiate purchase and to execute final purchasing agreements.

D. Owner Furnished, Contractor Installed Products (OFCI): The Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner furnished products and making building services connections when applicable.
   1. Owner Furnished Products: Coordinate with Owner.

1.6 ACCESS TO SITE

A. Use of Site: Limit use of Project site to Work in areas and areas within the Contract limits indicated. Do not disturb portions of site beyond areas in which the Work is indicated.
   1. Limits: The drawings indicate the limits of the construction operations.
   2. Driveways, Walkways, and Entrances: Keep driveways. parking areas, student drop off and pick up points, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, the students, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
      a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
      b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in weathertight condition throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner will occupy site and adjacent building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform Work to prevent interference with Owner's day to day operations. Maintain existing exits unless otherwise indicated.
   1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
   2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
   1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
   2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
   3. Before limited Owner occupancy, ensure mechanical and electrical systems are fully operational, and required tests and inspections and start up procedures are successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.

4. Upon occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.8 WORK RESTRICTIONS

A. Work Restrictions: Comply with restrictions on construction operations. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On Site Work Hours: Limit Work in the existing building to normal working hours, Monday through Friday, unless otherwise indicated. Coordinate with Owner when it is necessary to extend working hours or Work on weekends.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and after providing temporary utility services according to requirements indicated:
   1. Notify Owner not less than two weeks in advance of proposed utility interruptions.
   2. Obtain Owner’s written permission before proceeding with utility interruptions.

D. Noise, Vibration, and Odors: Coordinate operations that result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
   1. Notify Owner not less than two weeks in advance of proposed disruptive operations.
   2. Obtain Owner's written permission before proceeding with disruptive operations.

E. Controlled Substances, Firearms, and Explosive Devices: Use of tobacco products, controlled substances, firearms, and explosive devices on the site is not permitted.

F. Employee Identification: Provide identification tags for Contractor personnel working on site. Require personnel to use identification tags at all times.

G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on site.
   1. Maintain list of approved screened personnel with Owner's representative.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
   1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
   2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 1 General Requirements: Requirements of Sections in Division 1 apply to the Work of each specification section.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
   1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
   2. Abbreviations: Materials and products are identified by abbreviations.

1.10 CONSTRUCTION SCHEDULE

A. The Owner has a critical need for the Work to begin upon the Notice to Proceed and shall be Substantially Complete by January 25, 2019. There will ONLY be Extensions of Time due to adverse weather conditions.

B. The occurrence of unusually severe weather during the life of the Contract will be considered a basis for extending contract time when work is not already suspended for other reasons. Unusually severe weather means weather, which at the time of year that it occurs, is unusual for the place in which it occurs.

C. Extension of time for unusually severe weather will be determined on a monthly basis and will include only those actual adverse weather days in **excess of the normal adverse weather days included in the Contract Time**. Normal adverse weather means adverse weather which, regardless of its severity, is to be reasonable expected for that particular place at that particular time of year. The normal adverse weather days included in the Contract Time are based on historical records of temperature and precipitation.

EDINBURG, TEXAS

Average Days of Precipitation, 0.01 Inches or More											
Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5	2	5	3	3	4	3	2	7	4	5	5

Normal Monthly Precipitation, Inches											
Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1.57	1.38	1.10	1.34	2.68	2.52	2.80	1.97	3.86	2.64	1.14	1.06

D. Actual adverse weather days are those days meeting one or more of the criteria listed below. Time extensions for more than one criterion will take into consideration only that criterion having the greatest impact. Those actual adverse weather days in excess of the days listed in Table 12-1 will be allowed without regard to when they occur (except prior to mobilization or during suspension for other reasons) or their impact on contract completion.
   1. Days with maximum temperature of 32 degrees F or less – one full day allowed
   2. Days with minimum temperature of 32 degrees F or less, but whose maximum temperature is over 32 degrees F – one-half day allowed.
   3. Days when ½" or more of precipitation (rain or snow equivalent) occurs – one full day allowed.

E. Attached to the monthly Extension of Time Request, the CONTRACTOR shall submit a summary statement showing the number of days charged to the Contract for the preceding period.
   1. An itemized account of each day of the month showing which days meet one of the criteria outlined above.
   2. A total number of adverse weather days.
   3. The total number of days due to the CONTRACTOR for adverse weather days in excess of the normal adverse weather days.

END OF SECTION 01 10 00

SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements governing allowances.
   1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

B. Types of allowances include:
   1. Lump sum allowances.
   2. Unit cost allowances.
   3. Quantity allowances.
   4. Contingency allowances.
   5. Testing and inspecting allowances.

1.3 COORDINATION

A. Coordinate allowance items with other portions of the Work.

1.4 LUMP SUM, UNIT COST, AND QUANTITY ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight**,** and delivery to site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

   1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.5 CONTINGENCY ALLOWANCES

A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Contractor's related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation**,** taxes, insurance, equipment rental, and similar costs.

C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.

D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.6 TESTING AND INSPECTING ALLOWANCES

A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.

B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.

C. Costs of services not required by the Contract Documents are not included in the allowance.

D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.7 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
   1. Include installation costs in purchase amount only where indicated as part of the allowance.
   2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
   3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit cost allowances.
   4. Owner reserves the right to establish the quantity of Work in place by independent quantity survey, measure, or count.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
   1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
   2. No change to Contractor's indirect expense is permitted for selection of higher or lower priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related Work.

3.3 SCHEDULE OF ALLOWANCES

A.	Owner's Contingency Allowance:	$20,000.00
B.	Architect Standard Level of Care:	$15,000.00
C.	Irrigation and Landscaping Allowance:	$20,000.00

END OF SECTION 01 21 00

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes: Administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain Work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
   1. Alternates described are part of the Work when enumerated in the Agreement.
   2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent Work as necessary to completely integrate Work of the alternate into Project.
   1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other Work of the Contract.

C. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the Work described under each alternate.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. **Alternate No. 1**:
   1. General Contractor shall include alternate pricing to demo and resurface asphalt paving, striping, wheel stops and ADA signage in accordance with Civil and Architectural plans and specifications.

B. **Alternate No. 2**:
   1. General Contractor shall include alternate pricing to install structural concrete roof decking in accordance with Structural and Architectural plans and specifications. Refer to specification section 06 12 13.

END OF SECTION 01 23 00

SECTION 01 25 13 - PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Specified product compliance, and product quality assurance.

B. Specific administrative and procedural requirements for handling requests for substitutions made prior to award of Contract.

C. Requirements for product delivery, storage and handling.

1.3 RELATED REQUIREMENTS

A. Instructions to Offerors: Product options and procedures for submittal of requests for substitutions during the Proposal period.

1.4 DESCRIPTION OF REQUIREMENTS

A. Definitions: Definitions used in this Section are not intended to negate the meaning of other terms used in the Contract Documents, including such terms as “specialties”, “systems”, “structure”, “finishes”, “accessories”, “furnishings”, “special construction”, and similar terms. Such terms are self-explanatory and have recognized meanings in the construction industry.
   1. Products: Shall mean items purchased for incorporation in the Work, regardless of whether they were specifically purchased for the project or taken from the Contractor’s previously purchased stock. The term “product” as used herein includes the terms “material”, “equipment”, “system”, and other terms of similar intent.
      a. Named Products: Are those identified by the use of the manufacturer’s name for a product, including such items as a make or model designation, as recorded in published product literature, of the latest issue as of the date of the Contract Documents.
      b. Specified Products: same as Named Products.

   2. Materials: Shall mean products that must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, or installed to form units of work.
   3. Equipment: Is defined as a product with operational parts, regardless of whether motorized or manually operated, and in particular, a product that requires service connections such as wiring or piping.

1.5 PRODUCT QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same generic kind, from a single source, for each unit of work.
   1. When it is discovered that specific products are available only from sources that do not or cannot produce an adequate quantity to complete project requirements in a timely manner, consult with the Architect/Engineer for a determination of what product quantities are most important before proceeding. The Architect/Engineer will designate those qualities, such as visual, structural, durability, or compatibility, that are most important. When the Architect/Engineer’s determination has been made, select products from those sources that produce products that possess the most important qualities, to the fullest extent possible.

B. Compatibility of Options: Compatibility of products is a basic requirement of product selection. When the Contractor is given the option of selecting between two (2) or more products for use on the project, the product selected must be compatible with other products previously selected, even if the products previously selected were also Contractor options. The complete compatibility between the various choices available to the Contractor is not assured by the various requirements of the Contract Documents, but must be provided by the Contractor.

C. Or Equal:
   1. Where the phrase “or equal”, “or equivalent”, “or Architects approved equal”, or similar phrasing, occurs in the Proposal Documents, do not assume that materials, equipment, or methods of construction will be approved by the Architect unless the item has been specifically approved for this Work by the Architect.
   2. The decision of the Architect shall be final.

D. Where a proposed substitution involves the work of more than one (1) contractor, each contractor involved shall cooperate and coordinate the work with each other contractor involved, so as to provide uniformity and consistency and to assure the compatibility of products.

E. Foreign Product Limitations: “Foreign products” as distinguished from “domestic products” are defined as products that are either manufactured substantially (50 percent or more of value) outside of the United States and its possessions, or produced or supplied by entities known to be substantially owned (more than 50 percent) by persons who are not citizens of nor living within the United States and its possessions.
   1. Except under one (1) of the following conditions, select and provide domestic, not foreign, products for inclusion in the Work.
      a. There is no domestic product available that complies with the requirements of the Contract Documents.
      b. Available domestic products that comply with the requirements of the Contract Documents are available only at prices or other procurement terms that are substantially higher (25 percent or more) than for available foreign products that comply with the requirements of the Contract Documents.
      c. At the discretion of the Architect or Owner.

   2. Final determination and acceptance will be the responsibility of the Architect.

F. Standards: Refer to Section 01 41 00, Regulatory Requirements for the applicability of industry standards to the products specified for the Project, and for the acronyms used in the text of the Specification Sections.

1.6 SUBSTITUTIONS OF PRODUCTS

A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an Addendum as a substitution prior to the submission of proposals.

B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least seven (7) days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

C. If the Architect approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.

D. The Architect and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final

E. The following are not considered as substitutions:
   1. Revisions to the Contract Documents, when requested by the Owner, Architect, or any of their consultants are considered as “changes” not substitutions.
   2. Specified Contractor options on products and construction methods included in Contract Documents are choices made available to the Contractor and are not subject to the requirements specified in this Section for substitutions.
   3. Except as otherwise provided in the Contract Documents, the Contractor’s determination of and compliance with governing authorities do not constitute “substitutions” and do not constitute a basis for change orders.

F. The following may be considered as a reason for a request for substitution:
   1. The request is directly related to an “or approved equal” clause or similar language in the Contract Documents.
   2. The specified product or method of construction cannot be provided within the Contract Time in accordance with paragraph below concerning availability of specified items.
   3. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
   4. A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other consideration of merit, after deducting offsetting responsibilities the Owner may be required to bear. These additional responsibilities may include such considerations as additional compensation to the Architect/Engineer for redesign and evaluation services, the increased cost of other work by the Owner or separate contractors, and similar considerations.
   5. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.
   6. The specified product or method of construction cannot be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.
   7. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provides the required warranty.

G. Availability of specified items:
   1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.
   2. In the event specified items will not be so available, notify the Architect prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.
   3. The request will not be considered if the product or method cannot be provided as a result of the Contractor’s failure to pursue the work promptly or coordinate activities properly.
   4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.

H. A request constitutes a representation that Offeror:
   1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
   2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.

3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.

I. **No substitutions will be considered after the Award of Contract.**

1.7 SUBSTITUTION REQUEST SUBMITTAL

A. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request identify the product or fabrication or installation method to be replaced by the substitution; include related Specifications Section and Drawing numbers, and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate, with each request, the following information:
1. Product data, drawings and descriptions of products, fabrication and installation procedures.
2. Samples, where applicable or requested.
3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect, where applicable.
4. Coordination information, including a list of changes or modifications needed by other parts of the work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
5. A statement indicating the effect the substitution will have on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
6. Cost information, including a proposal of the net change, if any in the Contract Sum.
7. Certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal-to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including Architect/Engineer's re-design and evaluation costs resulting from the use of the proposed substitution.

B. Work-Related Submittals: The Contractor's submittal of, and the Architect/Engineer's acceptance of, Shop Drawings, Product Data, or Samples which are related to work not complying with the Contract Documents, does not constitute an acceptance or valid request for a substitution, nor approval thereof.

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Deliver, store, and handle products in accordance with manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft. Control to prevent overcrowding of construction spaces or overloading of structure. In particular, coordinate delivery and installation to ensure minimum holding or storage times for items known or recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other sources of loss.
1. Deliver products to the site in the manufacturer's sealed containers or other packaging system, complete with labels intact, and instructions for handling, storage, unpacking, installing, cleaning and protecting.

2. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation or potential degradation of product.
3. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
4. Store products at the site or in a bonded and insured off-site storage facility or warehouse in a manner that will facilitate inspection and measurement of quantity or counting of units. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.
5. Store heavy materials away from the project structure or in a manner that will not endanger the supporting construction.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT COMPLIANCE

A. General: Requirements for individual products are indicated in the Contract Documents; compliance with these requirements is in itself a contract requirement. These requirements may be specified in any one (1) of several different specifying methods, or in any combination of these methods. These methods include the following:
   1. Proprietary.
   2. Descriptive.
   3. Performance.
   4. Compliance with Reference Standards.

B. Compliance with codes, compliance with graphic details, allowances, and similar provisions of the Contract Documents also have a bearing on the selection process

C. Procedures for Selecting Products: The Contractor's options in selecting products are limited by requirements of the Contract Documents and governing regulations. They are not controlled by industry traditions or procedures experienced by the Contractor on previous construction projects. Required procedures include, but are not limited to the following for the various indicated methods of specifying:
   1. Proprietary and Semi-Proprietary Specification Requirements:
      a. Single Product Name: Where only a single product or manufacturer is named, provide the product indicated, unless the specification indicates the possible consideration of other products. Advise the Architect/Engineer before proceeding, when it is discovered that the named product is not a reasonable or feasible solution.
      b. Two (2) or More Product Names: Where two (2) or more products or manufacturers are named, provide one (1) of the products named, at the Contractor's option. Exclude products that do not comply with specification requirements. Do not provide or offer to provide an unnamed product, unless the specification indicates the possible consideration of other products. Advise the Architect/Engineer before proceeding where none of the named products comply with specification requirements, or are not feasible for use. Where products or manufacturers are specified by name, accompanied by the term "or approved equal" or similar language, comply with this Section regarding "substitutions" to obtain approval from the Architect/Engineer for the use of an unnamed product.

   2. Non-Proprietary Specification Requirements: Where the specifications name products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to the use of these products only, the Contractor may, at his option, use any available product that complies with the Contract requirements.
   3. Descriptive Specification Requirements: Where the specifications describe a product or assembly generically, in detail, listing the exact characteristics required, but without use

of a brand name, provide products or assemblies that provide the characteristics indicated and otherwise comply with Contract requirements.

4. Performance Specification Requirements: Where the specifications require compliance with indicated performance requirements, provide products that comply with the specific performance requirements indicated, and that are recommended by the manufacturer for the application indicated. The manufacturer's recommendations may be contained in published product literature, or by the manufacturer's individual certification of performance. General overall performance of a product is implied where the product is specified for specific performances.
5. Compliance with Standards, Codes, and Regulations: Where the specifications require only compliance with an imposed standard, code or regulation, the Contractor has the option of selecting a product that complies with specification requirements, including standards, codes, and regulations.
6. Visual Matching: Where matching an established sample is required, the final judgement of whether a product proposed by the Contractor matches the sample satisfactorily will be determined by the Architect. Where there is no product available within the specified product category that matches the sample satisfactorily and also complies with other specified requirements, comply with the provisions of this Section regarding "substitutions" and other Contract Documents for "change orders" for the selection of a matching product in another product category, or for non-compliance with specified requirements.
7. Visual Selection: Except as otherwise indicated, where specified product requirements include the phrase "…as selected from the manufacturer's standard colors, patterns, textures…" or similar phrases, the Contractor has the option of selecting the product and manufacturer, provided the selection complies with other specified requirements. The Architect is subsequently responsible for selecting the color, pattern and texture from the product line selected by the Contractor.
8. Allowances: Refer to individual sections of the specifications and Section 01 21 00, Allowances for an indication of product selections that are controlled by established allowances, and for the procedures required for processing such selections.

D. Producer's Statement of Applicability: Where individual specification sections indicate products that require a "Statement of Applicability" from the manufacturer or other producer, submit a written-certified statement from the producer stating that the producer has reviewed the proposed application of the product on the project. This statement shall state that the producer agrees with or does not object to the Architect/Engineer's specification and the Contractor's selection of the product on the project is suitable and proper.

2.2 SUBSTITUTIONS

A. Condition: The Contractor's request for substitution will be received and considered when extensive revisions to Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented and properly submitted, and when one (1) or more of the above conditions are satisfied, all as judged and determined by the Architect/Engineer; otherwise the requests will be returned without action except to record non-compliance with these requirements.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

A. General: Except as otherwise indicated in individual sections of these specifications, comply with the manufacturer's instructions and recommendations for installation of the products in the applications indicated.

B. Anchor each product securely in place, accurately located and aligned with other work.

C. Clean exposed surfaces and protect surfaces as necessary to ensure freedom from damage and deterioration at time of acceptance.

D. Products and assemblies shall be installed complete, in-place, watertight and structurally sound.

3.2 INSTALLATION OF APPROVED SUBSTITUTIONS

A. Coordinate all approved substitutions with adjacent work.

B. Comply with the manufacturer's and/or supplier's instructions and recommendations for installation of the products in the applications indicated.

C. Provide all items required by manufacturer and/or supplier regarding installation, i.e. supplemental supports, anchors, fasteners, painting, etc. whether or not indicated or specified.

END OF SECTION 01 25 13

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements for handling and processing Contract modifications.

B. Related Work:
   1. Section 01 25 13 – Product Substitution Procedures.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710 *Architect's Supplemental Instructions*.

1.4 PROPOSAL REQUESTS

A. Owner Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
   1. Work Change Proposal Requests issued by Architect are not instructions either to stop Work in progress or to execute the proposed change.
   2. After receipt of Proposal Request, submit quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
      a. Include list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
      b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
      c. Include costs of labor and supervision directly attributable to the change.
      d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
   1. Include statement outlining reasons for the change and the effect of the change on the Work. Provide complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
   2. Include list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
   3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
   4. Include costs of labor and supervision directly attributable to the change.
   5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times,

and activity relationship. Use available total float before requesting an extension of the Contract Time.

6. Comply with requirements in Section 01 25 00 if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use AIA Document G709.

1.5 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: When an allowance is specified, refer to Section 01 21 00 for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

1. Allowance Adjustment: To adjust allowance amounts, base each Change Proposal Request (CPR) on the difference between purchase amount and the allowance, multiplied by final measurement of Work in place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
   a. Include installation costs in purchase amount only where indicated as part of the allowance.
   b. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
   c. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit cost allowances.
   d. Owner reserves the right to establish the quantity of Work in place by independent quantity survey, measure, or count.

2. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the Purchase Order amount or Contractor's handling, labor, installation, overhead, and profit. Submit claims within 7 days of receipt of the Change Order authorizing work to proceed. Owner will reject claims submitted later than 7 days after authorization.

1.6 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Architect will execute a Change Order also requiring signatures of Owner and Contractor on AIA Document G701.

1.7 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work and designates the method to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of Work required by the Construction Change Directive. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 26 00

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

B. Pencil Copy: A preliminary review copy of the application for payment for review by Architect and Owner prior to submission of final copy.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
   1. Coordinate line items in the schedule of values with administrative forms and schedules, including the following:
      a. Application for Payment forms with continuation sheets.
      b. Updated Submittal schedule.
      c. Items required to be indicated as separate activities in updated Contractor's construction schedule.

   2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment. Contractor's standard form or electronic media printout will be considered but must be approved by the Owner.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
   1. Identification: Include the following Project identification on the schedule of values:
      a. Project name and location.
      b. Name of Architect.
      c. Architect's project number.
      d. Contractor's name and address.
      e. Date of submittal.

   2. Arrange schedule of values consistent with format of AIA Document G703.

   3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
      a. Related Specification Section or Division.
      b. Description of the Work.
      c. Name of subcontractor.
      d. Name of manufacturer or fabricator.
      e. Name of supplier.

      f. Change Orders (numbers) that affect value.

g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
   1) Labor.
   2) Materials.
   3) Equipment rentals.
   4) General Conditions.
      a. Supervisor.
      b. Submittals.
      c. Close-out.
      d. Field Engineering.
      e. Daily Clean-up.
      f. Final Clean-up.

4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

5. Provide separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
   a. Differentiate between items stored on site and items stored off site. Include evidence of insurance.

6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line item value of unit cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.

7. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
   a. Temporary facilities and other major cost items that are not direct cost of actual Work in place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

8. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Submit preliminary (pencil) copy of proposed values to Architect or Architects field representative and Owner for review by 20th date of the month. Allow 48 hours for comments.

B. Once preliminary (pencil) approved, submit electronic copy of notarized originals of each application on AIA Form G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet for G702 or other similar form approved by the Owner.

C. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.

D. Submit updated construction or recovery schedule with each Application for Payment.

E. Payment Period: Submit at intervals stipulated in the Agreement in accordance with Document 00 73 00, Supplementary Conditions of the Contract.

F. Only materials stored on the project site shall be paid for unless the materials are stored in a bonded warehouse.

G. Substantiating Data: When Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Items which may be requested by the Architect or Owner to substantiate costs include, but are not limited to the following:
   1. Current Record Documents as specified in Section 01 77 00, Closeout Procedures maintained.

2. Labor time sheets, purchase orders, or similar documentation.
3. Affidavits attesting to off-site stored products.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 29 00

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Div. 1 - General Reqs.								
	Site Work General Conditions								
	Supervision								
	Mobilization								
	Bonds & Insurance								
	Permits								
	Contractor's Fee								
	Close-Out Documents								
	Div. 1 - Total								
	Div. 2 - Existing Conditions								
	Demolition (As applicable)								
	Erosion Control								
	Div. 2 - Total								
	Div. 3 - Concrete								
	Drill Piers								
	Caps & Beams								
	Slab on Grade								
	Cooling Tower Basin								
	Misc Bldg Conc								
	Floor Sealer								
	Rebar Matl								
	Rebar Labor								
	Lt.Wt.Insul Fill - Materials								
	Lt.Wt.Insul Fill - Labor								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 3 - Total								
	Div 4 - Masonry								
	Brickwork - Labor								
	Brickwork - Matls								
	Concrete Masonry - Labor								
	Concrete Masonry - Materials								
	Str. Glazed Tile-Labor								
	Str. Glazed Tile-Materials								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 4 - Total								
	Div 5 - Metals								
	Structural Steel - Labor								
	Structural Steel - Materials								
	Alternating Stairs								
	Misc. Steel - Materials								
	Steel Joists - Materials								
	Lt. Gauge Steel Framing-Labor								
	Lt. Gauge Steel Framing-Matls								
	Metal Decking - Labor								
	Expansion Joint Covers								
	Metal Decking - Matls								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Detailing								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 5 - Total								
	Div. 6 - Wood & Plastics								
	Rough Carpentry - Labor								
	Rough Carpentry - Materials								
	Millwork - Labor								
	Millwork - Materials								
	Submittals/Close-Out Documents								
	Div. 6 - Total								
	Div. 7 - Thermal and Moisture Protection								
	Waterpfng / Dampprfng-Matls								
	Waterpfng / Dampprfng-Labor								
	Building Insulation - Labor								
	Building Insulation - Materials								
	Fireproofing - Labor								
	Fireproofing - Materials								
	Metal Roof - Labor								
	Metal Roof - Materials								
	Metal Roof Guarantee								
	Built-up Roofing-Labor								
	Built-up Roofing-Materials								
	Built-up Roofing Guarantee								
	Roof Accessories								
	Building Sheet Metal - Labor								
	Building Sheet Metal - Matls								
	Bldg. Sheet Metal Guarantee								
	Roof Curbs								
	Roof Hatches								
	Sealants								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 7 - Total								
	Div. 8 - Doors and Frames								
	Finish Carpentry/Door - Labor								
	Finish Hardware - Matls								
	Thresholds & Seals - Matls+B66								
	Hollow Metal Doors & Frames - Matls								
	Plastic Faced Doors-Matls								
	Overhead Doors & Grilles-Labor								
	Overhead Doors & Grilles - Matls								
	Alum. Entrances & Store-fronts - Labor								
	Alum. Entrances & Store-								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	fronts - Matls								
	Alum. Windows - Labor								
	Alum Windows - Matls								
	Glass & Glazing-Labor								
	Glass & Glazing-Matls								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 8 - Total								
	Div. 9 - Finishes								
	Lath & Plaster-Labor								
	Lath & Plaster-Matls								
	Gypsum Wallboard								
	Systems - Labor								
	Gypsum Wallboard								
	Systems - Matls								
	Ceramic Tile - Labor								
	Ceramic Tile - Matls								
	Quarry Tile - Labor								
	Quarry Tile - Matls								
	Terrazzo-Labor								
	Terrazzo-Matls								
	Acoustic Clg. - Labor								
	Acoustic Clg. - Matls								
	Acoustic Wall Panels								
	Resilient Flooring - Labor								
	Resilient Flooring - Matls								
	Carpet - Labor								
	Carpet - Matls								
	Athletic Flooring - Materials								
	Athletic Flooring - Labor								
	Floor Sealer								
	Painting - Labor								
	Painting - Mtls								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 9 - Total								
	Div. 10 - Specialties								
	Visual Display Boards &								
	Tackboards - Materials								
	Visual Display Boards &								
	Tackboards - Labor								
	Toilet Partitions - Labor								
	Toilet Partitions - Matls								
	Louvers								
	Aluminum Flag Pole								
	Graphics								
	Lockers								
	Cubicle Curtains & Track								
	Fire Extinguisher Cabinets								
	Demountable Partitions-Labor								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Demountable Partitions-Matls								
	Shelving								
	Toilet Room Accessories-Matls								
	Toilet Room Accessories-Lbr								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 10 - Total								
	Div. 11 - Equipment								
	Stage Curtains								
	Misc. Appliances								
	Food Service Eqpt-Labor								
	Food Service Eqpt-Matls								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 11 - Total								
	Div. 12 - Furnishings								
	Horizontal Blinds								
	Projection Screens								
	Casework - Labor								
	Casework - Matls								
	Science Casework - Labor								
	Science Casework - Matls								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 12 - Total								
	Div. 13 - Specialties								
	Stage Curtains and Draperies								
	Music Instrument Storage								
	Bleachers								
	Press Box								
	Pre-eng. Metal Bldg.								
	Stadium Seating								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 13 - Total								
	Div. 14 - Conveying Systems								
	Platform Lifts								
	Elevators								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 14 - Total								
	Div. 21, 22 - Plumbing								
	Shop Drawings								
	As-Builts/Close-Out/ O&M Manuals								
	Sanitary Underground -								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Labor								
	Sanitary Underground - Matls								
	Storm Underground - Labor								
	Storm Underground - Matls								
	Domestic Water - Labor								
	Domestic Water - Matls								
	Plumbing Insulation - Matls								
	Plumbing Insulation - Labor								
	Gas Piping - Matls								
	Gas Piping - Labor								
	Grease Trap								
	Plumbing Fixtures - Matls								
	Plumbing Fixtures - Labor								
	Coordination Drawings								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 21, 22 Plumbing - Total								
	Div. 23 - Mechanical								
	Shop Drawings								
	As-Builts/Close-Out/ O&M Manuals								
	Chillers - Matls								
	Chillers - Labor								
	Cooling Towers - Matls								
	Cooling Towers - Labor								
	Boilers - Matls								
	Boilers - Labor								
	AHU's - Matls								
	AHU's - Labor								
	Fans - Matls								
	Fans - Labor								
	Grilles - Matls								
	Grilles - Labor								
	Ductwork - Matls								
	Ductwork - Labor								
	Pumps - Mtls								
	Pumps - Labor								
	Water Treatment - Labor								
	Water Treatment - Matls								
	Isolation - Labor								
	Isolation - Matls								
	Pipe Flex - Matls								
	Pipe Flex - Labor								
	Connections								
	Sheet Metal - Matls								
	Sheet Metal - Labor								
	Duct Insulation - Matls								
	Duct Insulation - Labor								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Pipe Insulation - Matls								
	Pipe Insulation - Labor								
	VAV Boxes - Materials								
	VAV Boxes - Labor								
	Refrigerant Monitor - Matls								
	Refrigerant Monitor - Labor								
	Unit Heaters - Materials								
	Unit Heaters - Labor								
	Startup								
	Controls - Matls								
	Control - Labor								
	Engineer / Submittals								
	Modules / End Devices								
	Low Voltage Wiring								
	Startup								
	Close-Out Documents								
	Fire Sprinkler								
	Engineer / Submittals								
	Piping - Materials								
	Piping - Labor								
	Equipment - Materials								
	Equipment - Labor								
	Trimout - Materials								
	Trimout - Labor								
	Pipe, Valves, Fittings - Labor								
	Pipe, Valves, Fittings - Matls								
	Misc. - Matls								
	Insulation - Matls								
	Insulation - Labor								
	Sanitary Above Slab-Labor								
	Sanitary Above Slab-Matls								
	Storm Above Slab - Labor								
	Storm Above Slab - Matls								
	Gas - Labor								
	Gas - Matls								
	Fixtures - Labor								
	Fixtures - Matls								
	Permits								
	Coordination Drawings								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 23 Mechanical - Total								
	Div. 26 - Electrical								
	Mobilization+B220								
	Shop Drawings								
	As-Builts/Close-Out/ O&M Manuals								
	Underground								
	Conduit - Labor								
	Conduit - Matl								
	Wire - Labor								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Wire - Matls								
	Feeder Wire - Labor								
	Feeder Wire - Matls								
	Switches/Recpt.								
	Switchgear - Labor								
	Switchgear - Matls								
	Temporary - Materials								
	Temporary - Labor								
	Gas Generator - Materials								
	Gas Generator - Labor								
	Fixtures - Labor								
	Fixtures - Matls								
	Communications - Labor								
	Communications - Matls								
	Fire Alarm - Labor								
	Fire Alarm - Matls								
	Security - Labor								
	Security - Matls								
	Low Voltage Ltng Sys-Matls								
	Low Voltage Ltng Sys-Labor								
	Voice System - Materials								
	Voice System - Labor								
	Video System - Materials								
	Video System - Labor								
	Data System - Materials								
	Data System - Labor								
	Master Clock - Materials								
	Master Clock - Labor+B277								
	Coordination Drawings								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 26 - Total								
	Divs. 31, 32 and 33 - Earthwork, Exterior Improvements and Utilities								
	Site Clearing & Grubbing								
	Building Pad - Materials								
	Building Pad - Labor								
	Paving Subgrade								
	Signage / Striping								
	Bike Racks								
	Landscaping - Materials								
	Landscaping - Labor								
	Hydro Mulch - Materials								
	Hydro Mulch - Labor								
	Irrigation - Materials								
	Irrigation - Labor								
	Earthwork								
	Finish Grading								
	Stabilization - Materials								
	Stabilization - Labor								
	Site Drainage - Materials								
	Site Drainage - Labor								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Chain Link Fence-Materials								
	Chain Link Fence-Labor								
	Paving - Labor								
	Paving - Materials								
	Sidewalks								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 31, 32 and 33 - Total								
	General Conditions								
	Mobilization								
	Temp. Facilities								
	Final Cleaning								
	Record Documents/Close-out/ O&M Manuals								
	Supervision								
	Permits								
	Bonds								
	Insurance								
	Allowances								
	Alternates (list)								
	Change Orders								
	A. PR#								
	B. PR#								
	C. PR#								

END OF SECTION

SECTION 01 31 00 – PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. General coordination procedures.
   2. Coordination drawings.
   3. Pre-install meetings.

B. Each Contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific Contractor.

C. Contractor shall make a reasonable attempt to interpret the Contract Documents before asking the Architect for assistance in interpretation. Requests for Information (RFI's) will not be allowed from the Contractor. The Contractor shall arrange the necessary meeting in the field with appropriate Architect's field representative(s) to obtain clarification as needed on items that may need interpretation.

1.3 SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
   1. Name, address, and telephone number of entity performing subcontract or supplying products.
   2. Number and title of related Specification Section(s) covered by subcontract.
   3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
   1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.4 COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.

B. Coordination: Each Contractor shall coordinate its construction operations with those of other Contractors and entities to ensure efficient and orderly installation of each part of the Work. Each Contractor shall coordinate its operations with operations, included in different Sections, which depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components with other Contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include items as required notices, reports, and list of attendees at meetings.
   1. Prepare similar memoranda for Owner and separate Contractors if coordination of the Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Administrative activities include, but are not limited to, the following:
   1. Preparation of Contractor's construction schedule.
   2. Preparation of the schedule of values.
   3. Installation and removal of temporary facilities and controls.
   4. Delivery and processing of submittals.
   5. Progress meetings.
   6. Preinstallation conferences.
   7. Project closeout activities.
   8. Startup and adjustment of systems.
   9. Coordinating inspections and other jurisdictional requirements.
   10. Coordinate OFCI equipment.
   11. Action items and issue logs.

E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
   1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to the Specifications Sections for disposition of salvaged materials that are designated as Owner's property.

1.5 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
   1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
      a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
      b. Coordinate the addition of trade specific information to the coordination drawings by multiple Contractors in sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
      c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.

d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures, ductwork, piping, and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:
   a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
   b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
   c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:
   a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
   b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire alarm locations.
   c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
   d. Location of pull boxes and junction boxes, dimensioned from column center lines.
   e. Floor boxes.

8. Fire Protection System: Show the following:
   a. Locations of standpipes, mains piping, branch lines, pipe drops, sprinkler heads, and inspector test locations.

9. IDF/MDF Rooms: Communications and low voltage (security, data, phone, etc.) audio

10. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.

11. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 33 00.

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
   1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
   2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.
   3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
      a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
      b. Digital Data Software Program: Drawings are available in Revit.
      c. Contractor shall execute a data licensing agreement in the form of AIA Document C106.

1.6 PROJECT MEETINGS

A. Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
   1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
   2. Agenda: Architect to prepare the meeting agenda and distribute the agenda to all invited attendees.
   3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
   4. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
   5. Issue logs: Documentation element of software project management and contains a list of ongoing and closed issues of the project.

B. Kick-off & Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect.
   1. Conduct the conference to review responsibilities and personnel assignments.
   2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
   3. Agenda: Discuss items of significance that affect progress.
   4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
   5. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

C. Preinstallation Conferences: Conduct a preinstallation trade conference at site before each construction activity that requires coordination with other construction trades.
   1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect and Engineer of Record of scheduled meeting dates.
   2. Agenda: Contractor to review progress of other construction activities and preparations for the particular activity under consideration.
   3. Contractor to record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
   4. Reporting: Contractor to distribute minutes of the meeting to each party present and to other parties requiring information.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
6. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Substantial Completion.
2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout.
4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
5. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

E. Progress Meetings: Conduct progress meetings at weekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner and Architect, each Contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
    a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
    b. Six (6) week look-ahead schedules.

5. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

F. Coordination Meetings: Conduct coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
c. Review present and future needs of each Contractor present.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.
4. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 31 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
   1. Startup construction schedule.
   2. Contractor's construction schedule.
   3. Construction schedule updating reports.
   4. Daily construction reports.
   5. Material location reports.
   6. Site condition reports.
   7. Special reports.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
   1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
   2. Predecessor Activity: An activity that precedes another activity in the network.
   3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Float: The measure of leeway in starting and completing an activity.
   1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
   2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
   3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

F. Resource Loading: The allocation of manpower and equipment necessary for completion of an activity as scheduled.

G. Recovery Schedule: Submittal of a revised critical path method (CPM) schedule and a written plan.

H. Look-ahead Schedule: Prepare schedule indicating activities scheduled to occur or commence prior to submittal of next schedule update.

I. Milestones: Measurable and observable and serve as progress markers (flags) but, by definition, are independent of time (have zero durations) therefore no Work or consumption of resources is associated with them.

1.4 SUBMITTALS

A. Submittal Format: Submit required submittals in the following format:
   1. Working electronic copy of schedule file, where indicated.
   2. PDF electronic file.

B. Startup Diagram: Of size necessary to display entire network for entire construction period. Show logic relationship ties for all activities.

C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
   1. Submit a working electronic copy of schedule, labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
   1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
   2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
   3. Total Float Report: List of all activities sorted in ascending order of total float.
   4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.

E. Construction Schedule Updating Reports: Submit with Applications for Payment.

F. Daily Construction Reports: Submit at monthly intervals.

G. Material Location Reports: Submit at monthly intervals.

H. Site Condition Reports: Submit at time of discovery of differing conditions.

I. Special Reports: Submit at time of unusual event.

1.5 QUALITY ASSURANCE

A. Prescheduling Conference: Conduct conference at site. Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
   1. Review software limitations and content and format for reports.
   2. Verify availability of qualified personnel needed to develop and update schedule.
   3. Discuss constraints, including phasing, Work stages, area separations, interim milestones, and partial Owner occupancy.
   4. Review delivery dates for Owner furnished products.
   5. Review schedule for Work of Owner's separate contracts, if any.
   6. Review submittal requirements and procedures.
   7. Review time required for review of submittals and resubmittals.
   8. Review requirements for tests and inspections by independent testing and inspecting agencies.
   9. Review time required for Project closeout and Owner startup procedures.
   10. Review and finalize list of construction activities to be included in schedule.
   11. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
   1. Secure time commitments for performing critical elements of the Work from entities involved.
   2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Time is of the essence to the Owner. Commence Work immediately upon issuance of the Notice to Proceed. There is a critical need for the Work to be substantially complete within the time frame identified in the Agreement.

B. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion and date of final completion.
   1. Contract completion date shall not be changed by submission of schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each separate area or story as a separate numbered activity for each main element of the Work. Comply with the following:
   1. Activity Duration: Define activities in terms of number of days anticipated.
   2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
   3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
   4. Startup and Testing Time: Include number of days anticipated for startup and testing.
   5. Substantial Completion: Indicate completion of all conditions as in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
   6. Punch List and Final Completion: Include a maximum of 30 days for completion of punch list items and final completion.
   7. Inspections required by Authorities Having Jurisdiction (AHJ).

D. Constraints: Include constraints and Work restrictions indicated in the Contract Documents and show how the sequence of the Work is affected.
   1. Work Restrictions: Show the effect of the following items on the schedule:
      a. Coordination with existing construction.
      b. Limitations of continued occupancies.
      c. Uninterruptible services.
      d. Partial occupancy before Substantial Completion.
      e. Use of premises restrictions.
      f. Provisions for future construction.
      g. Seasonal variations.
      h. Environmental control.
      i. Rain days as indicated in Specification Section 01 10 00 Summary.

2. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
   a. Submittals.
   b. Mockups.
   c. Fabrication.
   d. Installation.
   e. Tests and inspections.
   f. Adjusting.
   g. Curing.

E. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.

F. Six (6) week, lookahead schedule: Prepare schedule indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
   1. Unresolved issues.
   2. Unanswered Requests for Information.
   3. Rejected or unreturned submittals.
   4. Notations on returned submittals.
   5. Pending modifications affecting the Work and Contract Time.
   6. Inspections by Authorities Having Jurisdiction (AHJ).
   7. Trade pre-installation conference.

G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

I. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time impact analysis to demonstrate the effect of the proposed change on the overall project schedule.

J. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
   1. Identification of activities that have changed.
   2. Changes in early and late start dates.
   3. Changes in early and late finish dates.
   4. Changes in activity durations in workdays.
   5. Changes in the critical path.
   6. Changes in total float or slack time.
   7. Changes in the Contract Time.

2.2 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording information concerning events at the site and submit each month to Architect:
   1. List of subcontractors at Project site.
   2. List of separate contractors at Project site.
   3. Approximate count of personnel at Project site.
   4. Rental equipment at Project site.
   5. Material deliveries.
   6. High and low temperatures and general weather conditions, including presence of rain or snow.
   7. Accidents.
   8. Meetings and significant decisions.
   9. Unusual events (see special reports).

10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of Authorities Having Jurisdiction (AHJ).
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
   1. Material stored prior to previous report and remaining in storage.
   2. Material stored prior to previous report and since removed from storage and installed.
   3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report and contact Architect Field Representative. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents to Architect Field Representative.

D. Special Reports: Submit special reports directly to Owner within 24 hours of an occurrence. Distribute copies of report to parties affected by the occurrence.
   1. Reporting Unusual Events: When an event of an unusual and significant nature occurs at site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, and response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner & Architect in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule with a pencil copy of pay application.
   1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
   2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
   3. As the Work progresses, indicate final completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and interested parties identified by Contractor with a need to know schedule responsibility.
   1. Post copies in Project meeting rooms and temporary field offices.
   2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01 32 00

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 DEFINITIONS

A. Submittals: Written and graphic information and physical samples that require Architect's responsive action or are for information and do not require the architect’s action.

B. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

C. Portable Document Format (PDF): An open standard file format used for representing documents in a device independent and display resolution independent fixed layout document format.

1.4 SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
   1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
   2. Initial Submittal: Submit concurrently with construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
   3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
   1. Upon request, Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
      a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
      b. Digital Drawing Software Program: The Contract Drawings are available in Revit.
      c. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement.
      d. The following digital data files will by furnished for each appropriate discipline:

1) Floor plans.
2) Reflected ceiling plans.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow ten (10) days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process in same manner as initial submittal.
3. Resubmittal Review: Allow ten (10) days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow ten (10) days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

D. Electronic Submittals: Identify and incorporate information in each electronic submittal file:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
4. Transmittal Form for Electronic Submittals: Use software generated form from electronic project management software acceptable to Owner**,** containing the following information:
a. Project name.
b. Date.
c. Name and address of Architect.
d. Name of Construction Manager.
e. Name of Contractor.
f. Name of firm or entity that prepared submittal.
g. Names of subcontractor, manufacturer, and supplier.
h. Category and type of submittal.

i. Submittal purpose and description.
j. Specification Section number and title.
k. Specification paragraph number or drawing designation and generic name for each of multiple items.
l. Drawing number and detail references, as appropriate.
m. Location(s) where product is to be installed, as appropriate.
n. Related physical samples submitted directly.
o. Indication of full or partial submittal.
p. Transmittal number, numbered consecutively.
q. Submittal and transmittal distribution record.
r. Other necessary identification.
s. Remarks.

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
   a. Project name.
   b. Number and title of appropriate Specification Section.
   c. Manufacturer name.
   d. Product name.

E. Options: Identify options requiring selection by Architect.

F. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
   1. Note date and content of previous submittal.
   2. Note date and content of revision in label or title block and clearly indicate extent of revision.
   3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
   1. Submit electronic submittals via email as PDF electronic files.
      a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
      OR
   2. Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.

3. Certificates and Certifications Submittals: Provide statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
    a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
    b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:
    a. Wiring diagrams showing factory installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in PDF electronic file.

C. Shop Drawings: Prepare Project specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.
    g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full size drawings, submit Shop Drawings on sheet size indicated in specification section.

3. Submit Shop Drawings in PDF electronic file.
4. BIM File Incorporation: Develop and incorporate Shop Drawing files into Building Information Model established for Project.
    a. Prepare Shop Drawings in same digital data software program, version, and operating system as the original Drawings.
    b. Refer to Section 01 31 00 for requirements for coordination drawings.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
   1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
   2. Identification: Attach label on unexposed side of Samples that includes the following:
      a. Generic description of Sample.
      b. Product name and name of manufacturer.
      c. Sample source.
      d. Number and title of applicable Specification Section.
      e. Specification paragraph number and generic name of each item.

   3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.

   4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
      a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
      b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

   5. Samples: Submit full size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
      a. Key Items Review Time: Submit samples to the Architect at least 30 days prior to the date the Contractor needs the reviewed submittals returned. The Contractor shall be prepared to submit color samples on any key items in Division 09 finishes within 30 days of the award of Contract. Once samples of all key items are received, the Architect will finalize color selections.
      b. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
         1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
         2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
   1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
   2. Manufacturer and product name, and model number if applicable.
   3. Number and name of room or space.
   4. Location within room or space.
   5. Submit product schedule in PDF electronic file.

F. Coordination Drawing Submittals: Comply with requirements specified in Section 01 31 00.

G. Contractor's Construction Schedule: Comply with requirements specified in Section 01 32 00.

H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 29 00.

I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 40 00.

J. Closeout Submittals required for Substantial Completion: Comply with requirements specified in Section 01 77 00.

K. Maintenance Data: Comply with requirements specified in Section 01 78 23.

L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

N. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

O. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

R. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

S. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
   1. Name of evaluation organization.
   2. Date of evaluation.
   3. Time period when report is in effect.
   4. Product and manufacturers' names.
   5. Description of product.
   6. Test procedures and results.
   7. Limitations of use.

U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

W. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

X. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
   1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and required submittals, submit digitally signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
   1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

C. BIM File Incorporation: Incorporate delegated design drawing and data files into Building Information Model established for Project.
   1. Prepare delegated design drawings in the same digital data software program, version, and operating system as the original Drawings.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

C. Incomplete submittals are not permitted, will be considered nonresponsive, and will be returned for resubmittal without review.

D. Submittals not required by the Contract Documents will be returned by the Architect without action.

END OF SECTION 01 33 00

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specific quality assurance and quality control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and quality control procedures that facilitate compliance with Contract Document requirements.
   3. Requirements for Contractor to provide quality assurance and quality control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions.
   4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

A. Quality Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
   1. Laboratory Mockups: Full size physical assemblies constructed at testing facility to verify performance characteristics.
   2. Integrated Exterior Mockups: Mockups of exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
   3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

G. Field Quality Control Testing: Tests and inspections performed on site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform particular construction operations, including installation, erection, application, and similar operations.
   1. Use of trade specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, *experienced* means having successfully completed a minimum of five years documented experience with projects similar in nature, size, and extent; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 SUBMITTALS

A. Shop Drawings: Submit plans, sections, and elevations, indicating materials and size of mockup construction.
   1. Indicate manufacturer and model number of individual components.
   2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

B. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting Work on the following systems:
   1. Seismic force resisting system, designated seismic system, or component listed in the designated seismic system quality assurance plan prepared by Architect.
   2. Main wind force resisting system or wind resisting component listed in the wind force resisting system quality assurance plan prepared by Architect.

C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
   1. Specification Section number and title.
   2. Entity responsible for performing tests and inspections.
   3. Description of test and inspection.

4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality control service.

1.6 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified. Include the following:
1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

E. Trade Preinstallation Conferences: Meeting minutes to be Contractor provided.

1.7 QUALITY ASSURANCE

A. Qualifications establish the minimum qualification levels required; refer to individual Specification Sections for additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated and sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated and with record of successful in service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling Work similar in material, design, and extent to that indicated for this Project, whose Work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of Texas, experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
   1. Requirements of authorities having jurisdiction supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
   1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
   2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products.

I. Factory Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
   1. Contractor responsibilities include the following:
      a. Provide test specimens representative of proposed products and construction.
      b. Submit specimens with sufficient time for testing and analyzing results to prevent delaying the Work.
      c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
      d. Build site assembled test assemblies and mockups using installers who will perform same tasks for Project.
      e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
      f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit certified written report of each test, inspection, and similar quality assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect a minimum of seven days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before starting Work, fabrication, or construction. Allow **seven** days for initial review and each re-review of each mockup.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed unless otherwise indicated.

L. Integrated Exterior Mockups: Mockup of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies shall be constructed. Mockup, if not specifically shown on the drawings, shall be minimum 8’x8’. Mockup shall include all major façade elements and at least one window minimum 2’x2’ in size. Prior to constructing mockup verify requirements with architect. Pre-installation conferences for trades involved in Integrated Exterior Mockup shall be held after mock up is completed.

M. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

N. Trade Preinstallation Conferences: Meeting minutes to be Contractor provided.

1.8 QUALITY CONTROL

A. Owner Responsibilities: Where quality control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform the services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality control activities required to verify that the Work complies with requirements, whether specified or not.
1. Unless otherwise indicated, provide quality control services specified and those required by authorities having jurisdiction. Perform quality control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform the quality control services. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality control service.

5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory authorized service representative to inspect field assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300.

D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.9 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner:

B. Special Tests and Inspections: Conducted by a qualified testing agency or special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections.
1. Verifying that manufacturer maintains detailed fabrication and quality control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00.

B. Protect construction exposed by or for quality control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality control services.

END OF SECTION 01 40 00

SECTION 01 45 23 - TESTING AND INSPECTING SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements and qualifications including but not limited to:
   1. Professional testing and laboratory services.
   2. Accessories necessary for the completion of testing and laboratory services.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specific quality assurance and quality control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and quality control procedures that facilitate compliance with Contract Document requirements.
   3. Requirements for Contractor to provide quality assurance and quality control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions.
   4. Specific test and inspection requirements are not specified in this Section.

C. A qualified independent testing laboratory and/or geotechnical engineering service selected and paid by Owner.
   1. The Owner will pay for the initial laboratory services of materials that comply with the requirements of the Contract Documents. The Contractor shall pay for testing and retesting of materials that do not comply with the requirements of the Contract Documents.

D. Inspecting agency shall perform inspections and tests in accordance with the rules and regulations of the building code, local authorities, Specifications of ASTM, and the Contract Documents.

E. Materials and workmanship found not in compliance with required standards or performance obligations shall be removed and replaced. Replacement and subsequent testing shall be at Contractor’s expense.

F. Where terms “Inspector” and “Laboratory” are used, it is meant and in reference to an officially designated and accredited inspector of the testing laboratory or geotechnical service engaged by Owner.

G. Laboratory inspections shall not relieve the Contractor or Fabricator of his responsibility to furnish materials and workmanship in accordance with the Contract Documents.

H. Contractor or Fabricator shall cooperate with the testing laboratory in matters pertaining to the Work.

I. Contractor to address deficiency and failed reports.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, documented according to ASTM E 329 and ASTM E534; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
   1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
   2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
   3. Testing agencies shall be insured against errors and omissions by a professional liability insurance policy having a minimum limit of liability of $500,000.00.

B. Inspection and testing services the of testing agency shall be under the direction of a Registered Engineer licensed in the State of Texas, charged with engineering managerial responsibility, and having a minimum of five (5) years engineering experience in inspection and testing of construction materials.

C. Concrete Inspectors: Inspecting personnel monitoring concrete Work shall be ACI certified inspectors.

D. Structural Steel: Primary inspectors performing structural steel inspection shall be currently certified AWS Certified Welding Inspectors (CWI), in accordance with the provisions of AWS QCI, *Standard and Guide for Qualification and Certification of Welding Inspectors*.
   1. Inspector may be supported by assistant inspectors who perform specific inspection functions under the direct supervision of the Primary Inspector. Assistant inspectors shall be currently certified AWS Certified Associate Welding Inspectors (CAWI). Work of assistant inspectors shall be monitored daily by the inspector.

E. Testing Equipment: Equipment shall be calibrated at intervals not exceeding 12 months by devices of accuracy traceable to the National Bureau of Standards.

F. Referenced Standards: Latest adopted edition of standards referenced apply to the Work. In the event of conflict between the Contract Documents and referenced standards, the Contract Documents shall govern. In case of conflict between Contract Documents and the Building Code, the more stringent shall govern.

1.4 QUALITY CONTROL

A. Owner Responsibilities: Where quality control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform the services.
   1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
   2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality control activities required to verify that the Work complies with requirements, whether specified or not.
   1. Refer to the individual specification sections for specific requirements.
   2. Unless otherwise indicated, provide quality control services specified and those required by authorities having jurisdiction. Perform quality control services required of Contractor by authorities having jurisdiction, whether specified or not.
   3. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform the quality control services. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

4. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
5. Where quality control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality control service.
6. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
7. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
8. Associated Responsibilities and Services: Cooperate with agencies performing required tests, inspections, and similar quality control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
    a. Provide access to the Work.
    b. Deliver of samples to testing laboratory, without cost to Owner, in adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
    c. Advise laboratory and Architect sufficiently in advance of construction operations to allow laboratory to complete required inspections or tests and to assign personnel for field inspection and testing as specified.
    d. Provide facilities for storage and curing of concrete test samples on site for the first 24 hours and for subsequent field curing required by ASTM C31.
    e. Incidental labor, facilities, and equipment necessary to assist laboratory personnel in obtaining and handling samples at the site.
    f. Preliminary design mix proposed for use for material mixes that require control by testing agency.
    g. Provide concrete mix designs in accordance with ACI 301 Section 3.9 made by an independent testing laboratory or qualified concrete supplier. Where mix designs by an independent testing laboratory are required, select and pay for laboratory.
    h. Obtain required inspections or approvals of the building official. Inspection requests and notifications required by building code are responsibility of the Contractor.
    i. Provide current welder certificates for each welder employed.
    j. Provide fabrication and erection inspection and testing of welds in accordance with AWS D1.1, Chapter 6.
        1) Use prequalification of welding procedures in executing the Work.
    k. Security and protection for samples and for testing and inspecting equipment at Project site.

9. Retesting/Reinspecting: Regardless of payment responsibility of the original tests or inspections, provide quality control services, including retesting and reinspecting, for construction that replaced Work failing to comply with the Contract Documents or Code requirements.

C. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

D. Coordination: Coordinate sequence of activities to accommodate required quality assurance and quality control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
   1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.5 AUTHORITY AND DUTIES OF LABORATORY PERSONNEL

A. A representative of the testing laboratory, who has reviewed and is familiar with the project and specifications, shall participate in preconstruction conferences. The representative shall coordinate material testing and inspection requirements with the Contractor and its subcontractors consistent with the planned construction schedule. The laboratory representative shall attend conferences required or requested to address quality control issues.

B. Laboratory personnel shall inspect and test materials, assemblies, specimens, and Work performed, including design mixes, methods and techniques and report the progress to the Architect.

C. If material or Work fails to meet requirements of Contract Documents, laboratory inspector shall notify the Construction Manager, Architect, Engineers, supplier or subcontractor providing or preparing the materials or Work being tested of such failure.

D. Laboratory personnel shall not perform the Work of the Contractor or act as foremen or superintendents. Work will be inspected as it progresses, but failure to detect defective Work or materials shall not prevent later rejection when a defect is discovered.

E. Laboratory personnel are not authorized to revoke, alter, relax, enlarge, or release the requirements of the Contract Documents or approve or accept portions of Work, except where approval is specifically specified in the Specifications.

F. Comply with building code requirements for Special Inspections.

1.6 SUBMITTALS

A. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
   1. Specification Section number and title.
   2. Entity responsible for performing tests and inspections.
   3. Description of test and inspection.
   4. Identification of applicable standards.
   5. Identification of test and inspection methods.
   6. Number of tests and inspections required.
   7. Time schedule or time span for tests and inspections.
   8. Requirements for obtaining samples.
   9. Unique characteristics of each quality control service.

C. Test and Inspection Reports: Prepare and submit certified written reports specified. Include the following:
   1. Date of issue.
   2. Project title and number.
   3. Name, address, and telephone number of testing agency.
   4. Dates and locations of samples and tests or inspections.
   5. Names of individuals making tests and inspections.
   6. Description of the Work and test and inspection method.
   7. Identification of product and Specification Section.

8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

D. Submit copies of reports of each inspection and test:
1. Owner, Program or Project Manager, Architect, and each Engineer or outside consultants regarding their particular phase of the project: One copy each.
2. Construction Manager and Contractor: Two copies each.

E. In addition to furnishing a written report, notify Construction Manager and Contractor verbally of uncorrected conditions or failures to comply with requirements of the Contract Documents, and immediately fax and email corresponding report to the Architect and Engineer.

F. At completion of each trade or branch of Work requiring inspecting and testing, submit a final certificate attesting to satisfactory completion of Work and full compliance with requirements of Contract Documents.

G. Submit copies of test results sealed by a Registered Engineer to municipal authorities having jurisdiction, as required.

1.7 TESTING LABORATORY GUIDELINES AND PROCEDURES

A. Technicians scheduled to perform specific testing services must be qualified to review and perform other services that overlap, i.e. earthwork, foundation inspections, rebar inspection, and concrete when scheduled concurrently at the site.

B. Technician time for services performed will be reimbursed at a regular time rate. Compensation at the overtime rate will be considered for hours over eight hours spent at the site on a single day, field testing services performed on a Saturday or Sunday, and field services performed on a recognized holiday.

C. There shall be a three hour minimum for each scheduled testing service. Vehicle charges will be included on a $25.00 per trip basis.

D. Cylinder pick up will be controlled by the technician performing test on a scheduled pick up day. If there are no testing services scheduled, the cylinder pick up fee is $40.00 on week days and $50.00 on weekends and holidays with no technician or vehicle charge.

E. The Contractor shall bear the responsibility of scheduling the testing services. The Contractor and the testing laboratory shall assume full responsibility to coordinate the testing services. Cancellations or failed test shall be reimbursable to the Owner by the responsible party for the cancellations or failure of a test or service.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.

2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.
5. Deficiency log.

B. Maintain log at site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 TESTING AND INSPECTION SERVICES

A. Testing services shall include, but not be limited to those specified below or which are necessary or required during course of construction to ascertain specification compliance and which may be deemed necessary by Architect, Engineer, or Owner to ensure the quality of the Work.

B. The Owner reserves the right to add to or delete any or all inspection and testing specified, excluding testing required by the applicable building codes.

C. If conflicts arise between Drawings and Specifications, notify Architect immediately. The most stringent requirements shall dictate procedure.

3.3 TESTING OF EARTHWORK

A. Testing Services (As specified or required):
1. References (As applicable for tests required):
   a. American Society for Testing and Materials (ASTM):
      1) D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3 (600 kN-m/m^3).
      2) D2922, Standard Test Method for Density of Soil and Soil-Aggregate In Place By Nuclear Methods (Shallow Depth).
      3) D4318, Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

   b. American Association of State Highway and Transportation Officials (AASHTO)
      1) T89, Determining the Liquid Limit of Soils.
      2) T90, Determining the Plastic Limit and Plasticity Index of Soils.
      3) T99, Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305-mm (12-in) Drop.
      4) T238, Density of Soil and Soil Aggregates In Place By Nuclear Methods (Shallow Depth).
2. Perform sieve analysis to develop grain size distribution curves for materials to be used for subgrade, fill under slab on grade, and backfills.
3. Establish the moisture density relation of soils to be used as fill using the method best suited to the type of fill material.
4. Determine moisture content of all fill materials before placement and advise Contractor when it is or is not suitable to achieve required compaction.
5. Determine Liquid Limit in accordance with ASTM D4318 or AASHTO T89, Plastic Limit in accordance with ASTM D4318, and Plasticity Index in accordance with ASTM D4318 of all fill material,
6. Perform one in place density test for each 4,000 square feet (445 square yards) of existing subgrade material.
7. Perform Moisture-Density curve in accordance with ASTM D698 or AASHTO T99 for one type of fill material. If the original choice of material does not meet the specifications, the Contractor shall pay for additional testing.
8. Perform in place density tests of each lift of compacted fill at locations adequate to evaluate the degree of compaction of all fill areas. Conduct one test for each 4,000 square feet (445 square yards) of each lift of compacted fill.

9. Perform testing at a frequency of one in-place density and moisture test for each 75 lineal feet or less of utility trench, with a minimum of three tests per lift.

B. Reports: Submit reports with the following information:
   1. Type and condition of soil at footing bottoms.
   2. Level of water table in the excavated areas.
   3. Grain size distribution of fill materials (average of three tests).
   4. Moisture density test results.
   5. In place density test results with moisture content and relative density of each layer of compacted fill. Include with in place density test results, a plan showing location of each test.
   6. Notify Architect by telephone within one hour of the discovery of the following conditions and follow up telephone notification with written report.
      a. Materials used, or degree of soil compaction not meeting specified requirements.
      b. Frost and freeze protection requirements for excavation bottoms not being complied with.
      c. Water in excavations which is not being removed prior to Work being performed in excavation.

3.4 INSPECTION OF PIPED SITE UTILITIES

A. Laboratory representative shall observe and report on the following:
   1. Proper alignment and grade of trenches.
   2. Pipe bedding and supports.
   3. Pipe, joints, jointing material, and thrust blocks prior to installation of pipe.
   4. Installation of pipe and joints.
   5. Testing of piped utilities performed by Contractor.

3.5 PAVING

A. Testing Services: Perform field tests for moisture density properties:
   1. Provide field testing of the subgrade as specified.
   2. Paving Subbase: Provide one field test for every 7,500 square feet of area of crushed limestone or caliche subbase.
   3. Lime Treated Subgrade: Provide one field test for every 7,500 square feet of area of lime treated subgrade for content of lime and subgrade compaction.
   4. Cement Soil Stabilization: Provide one field test for every 7,500 square feet of area of cement stabilized subgrade for content of cement and subgrade compaction.

3.6 PIER DRILLING OPERATION

A. A representative of a qualified geotechnical laboratory shall provide services specified.

B. Laboratory representative shall make continuous inspections to determine that proper bearing stratum is obtained and utilized for bearing and that shafts are properly clean and dry before placing concrete.

C. Laboratory shall furnish complete pier log showing the diameter, top and bottom elevations of each pier, casing required or not required, actual penetration into bearing stratum, elevation of top of bearing stratum, volume of concrete used, and deviations from specified tolerances.

D. Laboratory representative shall make continuous inspections of drilled pier construction to check the following:
   1. Verify soundness of bearing stratum and desired penetration.
   2. Verify pier dimensions and reinforcing used.
   3. Monitor condition of hole and removal of water and loose material from bottom.
   4. Monitor placement of concrete and use of tremie or pumps.

5. Monitor the extraction of casing, if used.

E. Request probe holes when deemed necessary to confirm safe bearing capacity.

3.7 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES

A. Inspect concrete reinforcing steel prior to placing concrete for compliance with Contract Documents and approved shop drawings. Noncompliance with Contract Documents and approved shop drawings shall be immediately brought to the attention of the Contractor for correction and, if left uncorrected, reported to the Architect.

B. Laboratory representative shall observe and report on the following:
1. Number and size of bars.
2. Bending and lengths of bars.
3. Splicing.
4. Clearance to forms, including chair heights.
5. Clearance to sides and bottom of trench if soil formed.
6. Clearance between bars or spacing.
7. Rust, form oil, and other contamination.
8. Grade of steel.
9. Securing, tying, and chairing of bars.
10. Excessive congestion of reinforcing steel.
11. Installation of anchor bolts and placement of concrete around such bolts.
12. Fabrication and installation of embedded metal assemblies, including visual inspection of all welds.
13. Visually inspect studs and deformed bar anchors on embedded assemblies for compliance with Contract Documents. Check number, spacing and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360 degree fillet has not been obtained for a particular stud or bar, such stud or bar shall be struck with a hammer and bent 15 degrees off perpendicular and then bent back into position. Anchors failing this test shall be replaced.

C. Provide a qualified, experienced inspector to inspect reinforcing steel. Inspector shall have a minimum of three years' experience inspecting reinforcing steel in projects of similar size.

3.8 CONCRETE INSPECTION AND TESTING

A. Receive and evaluate proposed concrete mix designs submitted by Contractor. If mix designs comply with Drawings and Specifications, the laboratory shall submit a letter to the Architect certifying compliance. Mix designs not complying with Drawings and Specifications shall be returned by the laboratory as being unacceptable. Check the proposed mixes for proportions, water cement ratio and slump in accordance with ACI 613 and 318.

B. Comply with ACI 311 *Guide For Concrete Inspection* and ACI *Manual of Concrete Inspection* (SP-2).

C. Sample and test concrete placed at the site in accordance with ASTM C172. Each sample shall be obtained from a different batch of concrete on a random basis.

D. Test concrete:
1. Mold and cure five specimens from each sample.
   a. For each 50 cubic yards or fraction thereof of structural building concrete; and
   b. For each 100 cubic yards or fraction thereof of nonstructural concrete and site Work paving and sidewalks.
   c. Laboratory cure two cylinders in accordance with ASTM C192.
   d. Field cure remaining cylinders in accordance with ASTM C31.

2. Two specimens shall be tested at seven days for information, two shall be tested at 28 days for acceptance.

E. Deviations from the requirements of ASTM Specifications shall be recorded in the test report. Test concrete specimens in accordance with ASTM C39.

F. Specimens for pumped concrete shall be taken at the discharge end of pumping equipment.

G. Supervise curing and protection provided for test specimens in field, and transportation from the field to laboratory. Test cylinders shall be stored in the field 24 hours and then carefully transported to laboratory and cured in accordance with ASTM C31.

H. Make one strength test (four cylinders) of each mix design of concrete placed in any one day.

I. Make one slump test for each set of cylinders following procedural requirements of ASTM C143 and ASTM C172. Make additional slump tests whenever consistency of concrete appears to vary. Slump tests corresponding to samples from which strength tests are made shall be reported with strength test results. Other slump tests need not be reported.

J. Determine total air content of air entrained normal weight concrete sample for each strength test in accordance with ASTM C231.

K. Determine air content and unit weight of lightweight concrete sample for each strength test in accordance with ASTM C173 and ASTM C567.

L. Determine temperature of concrete sample for each strength test.

M. Inspect each batch of concrete, monitor addition of mixing water to assure uniform consistency from truck to truck. Check mixing form mixers before mix begins to set and within time limits set forth in ASTM C94.
1. Monitor addition of water and high range water reducer to concrete at job site and length of time concrete is allowed to remain in truck during placement.

N. Testing agency shall furnish and maintain a competent inspector at the mixing plant at the start of each day's mixing. Inspector shall examine concrete materials for compliance with Specifications and approved mix design, weighing and measuring devices, proportioning and mixing of materials, water and cement content of each batch, general operation of the plant, and transportation of concrete to jobsite. Inspector shall verify that amount of free surface moisture contained in fine and course aggregate has been properly accounted for in the concrete mixing to achieve required consistency and water cement ratio.

O. Testing laboratory shall monitor addition of water to concrete at the jobsite and the length of time concrete is allowed to remain in the truck before placement. Inspector shall compare mixture with criteria on the approved mix design and report any significant deviation to the Architect, Contractor and concrete supplier. Do not permit addition of water which will exceed maximum water/cement ratio for the mix as given on the approved mix design.

P. Observe placing of concrete, except nonstructural slabs on grade and site Work. Observe and report on placing method, consolidation, cold joints, length of drop, and displacement of reinforcement. Report deficiencies to Contractor immediately for corrective action. Inspections may be reduced to a periodic basis when all procedures have been deemed satisfactory by the laboratory.

Q. Test reports shall include but no be limited to the following information: date of concrete placement, concrete mix identification number or proportion of ingredients, truck ticket number, time test was made, time of batching, location of each placement, slump, unit weight, water content (microwave test) and air content of concrete sampled and date and results of strength test.

R. Report promptly to Architect all details of reasons for rejection of any and all quantities of concrete. Give all information concerning locations of the concrete pours, quantities, date of pours, and other pertinent facts concerning concrete represented by the specimens.

S. Testing laboratory shall certify each delivery ticket indicating class of concrete delivered (or placed), amount of water added and time at which cement and aggregate were dispensed into the truck, and time at which concrete was discharged from the truck.

T. Evaluation and Acceptance:
   1. If measured slump, or air content of air entrained concrete, falls outside specified limits, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, concrete shall be considered to have failed to meet the requirements of the specifications, and shall not be used in the structure.
   2. Strength level of concrete will be considered satisfactory if the averages of sets of three consecutive strength tests results are equal to, or exceed, specified strength and no individual test result (average of two cylinders) is below specified strength by more than 500 psi.
   3. Completed concrete Work will be accepted when requirements of ACI 301 Chapter 18 *Specifications for Structural Concrete for Buildings* have been met.

U. Concrete Test Reports: Reports shall be made and distributed immediately after respective tests or inspections are made.
   1. Where reports indicate deviations from Contract Documents, they shall also include a determination of the probable cause of deviation and where applicable, a recommendation for corrective action.

V. Furnish a statistical analysis for each class of concrete placed on the project in accordance with ACI 214 and ACI 318. Information shall be updated and distributed once a month as directed by the Architect. Information shall include, but not be limited to, the following:
   1. Strength tests at 7 days of one cylinder.
   2. Strength tests at 28 days of two cylinder averages.
   3. 28 day moving average strength tests of last three test groups.
   4. Standard deviation and coefficient of variation based on 28 day strength tests.
   5. Average strength and number of 28 days tests for most recent month.

W. Test Footings (Shafts) (Piers) (Caissons): Same diameter and type specified for footings, placed in same manner. Accepted test footings may be used in the Work.

X. Noncompliant Test Reports: Fax test reports indicating noncompliance immediately to each party on the test report distribution list. Copies shall be on different colored paper.

Y. Inspect application of curing compound and monitor curing conditions to assure compliance with specification requirements. Report curing deficiencies to the Contractor immediately and submit a written report to the Architect.

3.9 TESTING OF NONSHRINK GROUT

A. Make one strength test for all plates grouted and for all grout used in joints between members.

B. Each test shall consist of four cubes, two tested at 7 days and two at 28 days, made and tested in accordance with ASTM C109, with the exception that grout shall be restrained from expansion by a top plate.

3.10 STRUCTURAL STEEL

A. Inspect structural steel during and after erection for compliance with Contract Documents and shop drawings. Review and report on fabricator's quality control procedures and capabilities.

B. Field Inspection:
   1. Proper erection of pieces.
   2. Proper touch up painting of shop primed structural steel exposed to view or in crawl space.
   3. Proper installation of bolts.
   4. Plumbness of structure and proper bracing.
   5. Proper field painting.
   6. Initial inspection of welding process and periodically thereafter as necessary.
   7. Visual examination of completed welds.
   8. Ultrasonic testing of penetration field welds.
   9. Installation of field welded shear studs.
   10. Inspect shop fabricated members, upon arrival at the site, for defects incurred during transit and handling.
   11. Measure and record camber of beams upon arrival and before erection for compliance with specified camber. Measure lying flat with web horizontal. Return members outside specified camber tolerance to shop for correction.

C. Qualifications of Welders: Fabricator and erector shall provide the testing laboratory with names of welders employed on Work, along with certification that each welder has passed qualification tests within the past 12 months, using procedures covered in AWS D1.1 *Structural Welding Code - Steel*. Verify welder qualifications.

D. Inspection of field welding shall include:
   1. Visually inspect fillet welds for size, soundness, and proper return around ends. Inspect seams, folds, and delaminations.
   2. Visually inspect welds for proper repair of painting.
   3. Ultrasonically test penetration welds in accordance with ASTM E164.
   4. Inspect surfaces to be welded. Note surface preparations, fit up, and cleanliness of surface. Verify electrodes for size, type, and condition.
   5. Welding inspector shall be present during alignment and fit up of members being welded, and shall verify for correct surface preparation of root openings, sound weld metal, and proper penetration in the root pass. Where weld has not penetrated completely, inspector shall order the joint to be chipped down to sound metal, or gouged out, and rewelded. Thoroughly inspect root passes for cracks. Gouge out cracks and rewelded to 2 inches beyond each end of crack.
   6. Inspector shall verify that welds have been marked with welder's symbol and shall mark welds requiring repairs and reinspection. Inspector shall maintain a written record of welds. Work completed and inspected shall receive an identification mark by the inspector. Identify unacceptable material and Work identified by word *reject* or *repair* marked directly on the material.
   7. Testing agency shall advise the Owner and Architect of any shop and/or field conditions which may require further tests and examination by means other than those specified. Additional tests and examinations shall be performed as authorized by the Owner and Architect.
   8. Owner reserves the right to use ultrasonic or radiographic inspection to verify adequacy of welds. Testing procedures and acceptance criteria shall be as specified in AWS D1.1.
   9. Weld quality to comply with the American Institute of Steel Construction (AISC) Manual of Steel Construction.
   10. Determine percentage of weld tested by the number of welds that fail the initial testing.
   11. Reweld and retest welds that fail until the welds pass. Test two additional welds for every weld failure.

E. Inspect bolted construction in accordance with AISC *Specification for Structural Steel Buildings*:
   1. Visually inspect bolts ensuring that plies have been brought into snug contact.
   2. Inspect high strength bolt in accordance with Section 9 of the *Specifications for Structural Joints Using ASTM A325 or A490 Bolts*.

F. Inspect stud welding in accordance with Section 7.8, of AWS D1.1 *Structural Welding Code*:
   1. Weld at least two shear studs at the start of each production period to determine correct generator, control unit, and stud welder setting. The studs shall be capable of being bent 45 degrees from vertical without weld failure.
   2. When the temperature is below 32 degrees F (0 degrees C), test one stud in each 100 after cooling. Do not weld studs at temperatures below 0 degrees F or when surface is wet with rain or snow. If stud fails in the weld, two new studs shall pass the test before resumption of welding.
   3. Visually inspect studs for compliance with the requirements of the Contract Documents. Verify number, spacing, and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360 degree fillet has not been obtained for a particular stud, that stud shall be struck with a hammer and bent 15 degrees off perpendicular in the direction away from the missing weld. Studs failing test shall be replaced.

3.11 REINFORCING STEEL MECHANICAL SPLICES

A. Inspection and Observation Services:
   1. Visually inspect and report on completed condition of each mechanical splice of reinforcing steel.
   2. Visually inspect each mechanical splice to ensure compliance with the ICC-ES Reports and the manufacturer's published criteria for acceptable completed splices.
   3. Place special emphasis on the inspection of the end preparation of each bar to be spliced required by the ICC-ES Report.

B. Reports: Submit reports to Architect:
   1. Submit copies of manufacturer's published criteria for acceptable completed splices prior to observing mechanical splices.
   2. Reports on each mechanical splice shall indicate location of the splice, size of bars spliced, and acceptability or rejection of splice. Indicate reasons for rejection on each report.

3.12 OPEN WEB JOISTS AND JOIST GIRDERS

A. Inspect joists at jobsite for compliance with specified fabrication requirements. Verify welded connections between web and chord, splices, and straightness of members.

B. Inspect installation of joists at jobsite. Check connections to supporting members, chord extensions, number of rows of bridging, and bridging connections for compliance with Contract Documents and referenced standards.

C. Verify welder qualification certificates for both shop and field welding operators.

3.13 METAL FLOOR DECK

A. Field inspection shall consist of:
   1. Verifying types, gauges and finishes for compliance with Contract Documents and shop drawings.
   2. Examine composite floor deck exposed to crawl space for damage to galvanizing due to welding or construction activities. Repair galvanized composite floor deck in accordance with the specifications.
   3. Examine the erection of metal deck, fastenings, reinforcing of holes, deck reinforcing, miscellaneous deck supports, hanger tabs, shear studs, deck closures, painting or other coating.
   4. Certification of welders.
   5. Inspect and test field welded shear studs used to fasten metal floor decking to supporting steel as specified for structural steel.

3.14 METAL ROOF DECK

A. Field inspection shall consist of:
   1. Verify types, gauges and finishes for compliance with Contract Documents and shop drawings.
   2. Examine the erection of the metal deck, including fastenings at supports and side laps, reinforcing of holes, and miscellaneous deck supports.
   3. Certification of welders.
   4. Visual inspection of at least 25 percent of welds.

3.15 SPRAYED FIREPROOFING

A. Verify applied thickness, density, and bond strength of sprayed fireproofing meets fire rating requirements of approved design.

B. Verify installation complies with fire rating requirements of approved design.

C. Inspect and test for thickness:
   1. Test 25 percent of structural frame columns and beams in each building level.
   2. Test 10 percent of beams other than structural frame in each building level.
   3. Test one slab per 5,000 square feet of building area.

D. Inspect and test in accordance procedures of ASTM E605 and ASTM E736.

3.16 EXPANSION BOLT INSTALLATION

A. Inspect drilling of each hole and installation of each expansion bolt for compliance with Contract Documents and shop drawings.

B. Verify installation torque for each expansion bolt for compliance with manufacturer's installation instructions.

3.17 LIGHTWEIGHT INSULATING CONCRETE FILL

A. Inspection and Observation Services (As required):
   1. Inspection of roof deck prior to start of Work.
   2. Inspection during installation of insulation and lightweight insulating concrete fill Work to ascertain compliance with Contract Documents.
   3. Observation of base ply fastener pull tests performed by Contractor to ascertain minimum withdrawal resistance of 40 pounds per fastener.

B. Testing Services (As required):

   1. References (As applicable for tests required):
      a. American Society for Testing and Materials (ASTM)
         1) C177, Standard Test Method for Steady State Heat Flux Measurements and Thermal Transmission Properties By Means of the Guarded Hot Plate Apparatus
         2) C495, Test Method for Compressive Strength of Lightweight Insulating Concrete
         3) C578, Specification for Rigid, Cellular Polystyrene Thermal Insulation.
   2. Test EPS insulation board for thermal insulation value in accordance with ASTM C177.
   3. Test lightweight insulating concrete fill in accordance with ASTM C495 for:
      a. Mix design compressive strength.
      b. Mix design wet and dry density range.
      c. Number of Tests:
         1) One per 5,000 square feet.
         2) Not less than one for each day's Work.

4. Test EPS insulation board for density in accordance with ASTM C578.

3.18 TESTING OF ROOFING

A. Inspection and Observation Services (As required):
   1. Inspection of roof deck prior to start of Work.
   2. Inspect on site condition of stored roofing materials.
   3. Inspection during roofing, roof insulation, and sheet metal Work to ascertain compliance with Contract Documents.
   4. Observation of roof test cuts performed by Contractor to ascertain that they are properly made.
   5. Observation of patching of roof test cuts to ascertain that they are properly made.

B. Testing Services (As required):
   1. Perform dissection and analysis on cuts provided by Contractor to confirm number of plies, bonding of plies, weight of bitumen and softening temperature to ascertain compliance with specifications.

3.19 MASONRY

A. Inspection and Observation Services:
   1. Inspection of placement of reinforcement including condition, grade, size, location, spacing, and lap splices.
   2. Review mortar design mixes.
   3. Inspection of laying, mortaring, and grouting of concrete masonry units and elements.

B. Testing Services:

   1. References (As applicable for tests required):
      a. ASTM International (ASTM)
         1) C140, Standard Test Methods of Sampling and Testing Concrete Masonry Units
         2) C780, Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
         3) C1019, Standard Test Method for Sampling and Testing Grout
         4) E447-97, Standard Test Methods for Compressive Strength of Laboratory Constructed Masonry Prisms.

   2. Testing of Concrete Masonry Units (CMU):
      a. Preconstruction: Perform the following tests in accordance with ASTM C140.
         1) Compressive Strength
         2) Absorption
         3) Weight
         4) Moisture Content
         5) Dimensions.

   3. Mortar Tests:
      a. Preconstruction: Perform the following tests in accordance with ASTM C780 on each type of mortar mix used on the Project.
      b. 28 Day Compressive Strength
      c. Water Retention
      d. Construction: Perform 28 day compressive strength test in accordance with ASTM C780 on each type of mortar mix used on the Project at the rate of one test per 2,000 square feet of masonry.

   4. Refer to and include Work for reinforcing steel specified.
   5. Grout Tests:

a. Preconstruction: Perform the following tests in accordance with ASTM C1019 on each type of grout mix used on the Project.
   1) 28 Day Compressive Strength
   2) Construction: Perform 28 day compressive strength test in accordance with ASTM C1019 on each type of grout mix used on the Project at the rate of one (1) test per 2,000 square feet of masonry.
   3) Prism Test: Perform preconstruction 28 day compressive strength test on concrete masonry walls in accordance with ASTM E447-97, Method B.

3.20 REPAIR AND PROTECTION

A. On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
   1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 30.

B. Protect construction exposed by or for quality control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality control services.

END OF SECTION 01 45 23

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements for selection of products, including but not limited to:
   1. Product delivery, storage, and handling.
   2. Manufacturers' written warranties on products.
   3. Special warranties.
   4. Comparable products.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term *product* includes the terms *material*, *equipment*, *system*, *assembly*, and terms of similar intent.
   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
   3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis of Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words *basis of design product*, including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Include data to indicate compliance with the specified requirements.
   2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
      a. Form of Approval: As specified in Section 01 33 00.

b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

B. Basis of Design Product Specification Submittal: Comply with requirements in Section 01 33 00. Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:
1. Schedule delivery to minimize long term storage at site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:
1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
   1. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
   2. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 01 77 00.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
   1. Provide products complete with accessories, trim, finish, fasteners, and items needed for complete installation and indicated use and effect.
   2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
   4. Where products are accompanied by the term “as selected”, Architect will make selection.
   5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Product Selection Procedures:
   1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
   2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
   3. Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
   4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
   5. Basis of Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and characteristics based on the product named. Comply with requirements for consideration of an unnamed product by one of the named manufacturers.

C. Visual Matching Specification: Where Specifications require “*match Architect's sample”*, provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
   1. If no product available within specified category matches and complies with specified requirements, comply with requirements of Section 01 25 00 for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase “*selected by Architect”* or similar phrase, select a product that complies with requirements. Architect will select color,

gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
   1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
   2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
   3. Evidence that proposed product provides specified warranty.
   4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
   5. Samples, if requested.

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 60 00

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
   1. Construction layout.
   2. Field engineering and surveying.
   3. Installation of the Work.
   4. Coordination of Owner-installed products.
   5. Progress cleaning.
   6. Starting and adjusting.
   7. Protection of installed construction.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair Work required to restore construction to original conditions after installation of other Work.

1.4 SUBMITTALS

A. Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.

B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

C. Certified Surveys: Submit two copies signed by land surveyor.

D. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor legally qualified to practice in the State of Texas, who is experienced in providing land surveying services of the kind indicated.

B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

B. In Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not warranted. Before beginning site Work, investigate and verify existence and location of underground utilities, mechanical and electrical systems, and construction affecting the Work.
1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water service piping; underground electrical services, and other utilities.
2. Furnish location data for Work related to the Work that must be performed by public utilities serving the site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation after correcting unsatisfactory conditions. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 01 31 00.

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.
1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as necessary to locate each element of Project.
2. Establish limits on use of site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical Work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control Work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other Work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Engage a land surveyor or professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor or professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical Work plumb and make horizontal Work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions ensuring the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.

3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous. Materials containing asbestos and BCPs are prohibited.

3.6 OWNER INSTALLED PRODUCTS

A. Site Access: Provide access to site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with Work performed by Owner's construction personnel.
1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's Work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

A. Clean site and Work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 degrees F (27 degrees C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
   a. Use containers intended for holding waste materials of type to be stored.
4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed Work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 50 00.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with mechanical, plumbing, and electrical requirements.

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00.

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 73 00

SECTION 01 73 29 – CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Procedural requirements for cutting and patching.

1.3 DEFINITIONS

A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair Work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

A. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
   1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
   2. Changes to In Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
   3. Products: List products used for patching and firms or entities that will perform patching Work.
   4. Dates: Indicate when cutting and patching will be performed.
   5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
      a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

1.5 QUALITY ASSURANCE

A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

B. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.

C. Operational Elements: Do not cut and patch operating elements and related components that results in reducing the capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
   1. Primary operational systems and equipment.
   2. Fire separation assemblies.
   3. Air or smoke barriers.
   4. Fire suppression systems.
   5. Mechanical systems piping and ducts.

6. Control systems.
7. Communication systems.
8. Fire-detection and -alarm systems.
9. Conveying systems.
10. Electrical wiring systems.
11. Operating systems of special construction.

D. Miscellaneous Elements: Do not cut and patch the following elements or related components that change the load bearing capacity, resulting in a reduction of capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Exterior curtain wall construction.
4. Equipment supports.
5. Piping, ductwork, vessels, and equipment.
6. Noise and vibration control elements and systems.
7. Sprayed fire resistive material.

E. Visual Requirements: Do not cut and patch construction resulting in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
1. If possible, retain original Installer or fabricator to cut and patch exposed Work. If possible, engage original Installer or fabricator. If original installer is not available, engage recognized, experienced, and specialized firm for the Work.
    a. Processed concrete finishes.
    b. Ornamental metal.
    c. Matched veneer woodwork.
    d. Preformed metal panels.
    e. Roofing.
    f. Firestopping.
    g. Window system.
    h. Fluid applied flooring.
    i. Wall covering.
    j. HVAC enclosures, cabinets, or covers.

F. Cutting and Patching Conference: Before proceeding, meet at site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with specified requirements.

B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
   1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
   2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Services: Where removal, relocation, or abandonment is necessary, bypass existing services before cutting to avoid interruption of services to occupied areas.

3.3 CUTTING AND PATCHING

A. Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at earliest feasible time, and complete without delay.
   1. Cut existing construction to provide for installation of components or performance of construction, and subsequently patch as necessary to restore surfaces to an original condition.

   2. Cut in place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Temporary Support: Provide temporary support of Work to be cut.

C. Protection: Protect in place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

D. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 10 00.

E. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
   1. Use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Finished Surfaces: Cut or drill from exposed or finished side into concealed surfaces.
   3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

4. Excavating and Backfilling: Comply with requirements in applicable earthwork specifications by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction to eliminate evidence of patching and refinishing.
    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions are removed, extend one finished area into another, patch and repair surfaces in new space. Provide even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.
4. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
5. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
6. Exterior Building Enclosure: Patch components and restore enclosure to a weathertight condition.

END OF SECTION 01 73 29

SECTION 01 77 00 CLOSEOUT FORMS

CLOSE-OUT FORM "A"

SUBCONTRACTOR'S AFFIDAVIT OF RELEASE OF LIEN

STATE OF _____

COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says:

1. That he / she is the _____ of _____, the subcontractor who supplied, installed, and /or erected the work described below, and that, he /she is duly authorized to make this Affidavit and Subcontractor Release:

   Project: Waste Water Treatment Plant Office
   Owner: City of Edinburg Architect: PBK
   Work Performed: _____ Specification Section(s): _____

2. That all work required under the subject subcontractor of the subject construction project has been performed in accordance with the terms thereof, that all material men, sub-subcontractors, mechanics, and laborers have been paid and satisfied in full and that there are no outstanding claims of any character arising out of the performance of said subcontractor which have not been paid and satisfied in full.

3. That to the best of his / her knowledge and belief, there are no unsatisfied claims for damages resulting from injury or death to any employees, sub-subcontractors, or the public at large arising out of the performance of said subcontract, or any suits or claims for any other damages of any kind, nature, or description which might constitute a lien upon the property of the Owner.

4. That he / she has received full payment of all sums due him / her for materials furnished and services rendered by the undersigned in connection with the performance of said subcontract and has and does hereby release the Owner and the Architect and his consultants and the Contractor from any and all claims of any character arising out of or in any way connected with performance of said subcontract.

ATTEST (If Corporation)

_____
Name of Subcontractor

_____ _____
Secretary (By) (Title)

JURAT

STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20_____.

_____

(Seal)

(Notary Public Signature)

CLOSE OUT FORM "B"

CERTIFICATION OF PROJECT COMPLIANCE

Completion of this form is required under the provisions of §61.1036(c)(3)(F) TAC for all public school district construction projects. Instructions for completion of this form can be found on page 2.

1. PROJECT INFORMATION

DISTRICT:

Facility:

ARCHITECT/ENGINEER:

Address:

CONTRACTOR/CM:

City:

CONTRACT DATE:

DATE DISTRICT AUTHORIZED PROJECT:

BRIEF DESCRIPTION OF PROJECT:

2. CERTIFICATION OF DESIGN AND CONSTRUCTION

The intent of this document is to assure that the school district has provided to the architect/engineer the required information and the architect/engineer has reviewed the School Facilities Standards as required by the State of Texas, and used his/her reasonable professional judgment and care in the architectural/engineering design and that the contractor has constructed the project in a quality manner in general conformance with the design requirements and that the school district certifies to project completion.

3. The District certifies that the educational program and the educational specifications of this facility along with the identified building code to be used have been provided to the architect/engineer.

DISTRICT: **BY:** **DATE:**

4. The Architect/Engineer certifies the above information was received from the school district, and that the building(s) were designed in accordance with the applicable building codes. Further, the facility has been designed to meet or exceed the design criteria relating to space (minimum square footage), educational adequacy, and construction quality as contained in the School Facilities Standards as adopted by the Commissioner of Education, June 9, 2003, and as provided by the district.

ARCHITECT/ENGINEER: **BY:** **DATE:**

5. The Contractor/CM certifies that this project has been constructed in general conformance with the construction documents as prepared by the architect/engineer listed above.

CONTRACTOR/CM: **BY:** **DATE:**

6. The District certifies completion of the project (as defined by the architect/engineer and contractor).

DISTRICT: **BY:** **DATE:**

INSTRUCTIONS FOR COMPLETION OF "CERTIFICATION OF PROJECT COMPLIANCE" FORM

Section 1. Identify the following:
- – name and address of the school facility
- – name of the school district
- – the Architect/Engineer and Contractor
- – the date of execution of the construction contract
- – the date that the school district authorized the superintendent to hire an architect/engineer
- – scope of the project.

Section 2. This section outlines the intent of the document. No action required.

Section 3. This section is to be executed by the school district upon transmittal of the information (as listed) to the architect/engineer and is to remain in the custody of the school district throughout the entire project.

Section 4. This section is to be executed by the architect/engineer upon completion of the plans and specifications and in conjunction with the completion of the plan review for code compliance (ref. 19 TAC §61.1033 or §61.1036, School Facilities Standards) and returned to the school district's files.

Section 5. This section is to be executed by the contractor upon substantial completion of the project and retained in the school district's files.

Section 6. This section is to be executed by the school district upon acceptance and occupancy of the project.

NOTE: DO NOT SUBMIT THIS DOCUMENT TO THE TEXAS EDUCATION AGENCY. The school district will retain this document in their files indefinitely until review and/or submittal is required by representatives of the Texas Education Agency.

CLOSE-OUT FORM "C"

SUBCONTRACTOR HAZARDOUS MATERIAL CERTIFICATE

THE STATE OF _____

COUNTY OF _____

PROJECT: Waste Water Treatment Plant Office

OWNER: City of Edinburg

ARCHITECT: PBK

SPECIFICATION SECTION(S):

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says that he / she is the _____ of _____,the subcontractor / supplier who constructed or provided the section(s) of work referenced above, and that he / she is duly authorized to certify to the best of his / her information, knowledge, and belief no asbestos, lead or PCB containing products have been incorporated into the project.

ATTEST (If Corporation)

_____
Name of Subcontractor / Supplier

_____ _____
Secretary (By) (Title)

JURAT

THE STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20_____.

(Seal)

_____
(Notary Public Signature)

CLOSE-OUT FORM "D"

SUBCONTRACTOR WARRANTY

STATE OF _____

COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says:

1. That he / she is the Subcontractor (or the _____of_____ the subcontractor) who supplied, installed, and / or erected the work described below, and that, he / she is duly authorized to make this Subcontractor Warranty:

   Project: Waste Water Treatment Plant Office
   Owner: City of Edinburg Architect: PBK
   Work Performed: _____ Specification Section(s): _____

2. The undersigned Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract are of good quality and new except where otherwise required or permitted by the Contract Documents, that the Work is free from defects not inherent in the quality required or permitted, and that the Work conforms with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Subcontractor's warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Subcontractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage.

3. In the event of failure of materials, products, or workmanship, during the specified warranty periods, the Subcontractor shall take appropriate measures to assure correction or replacement of the defective items, whether notified by the Contractor, Owner or Architect.

4. The Subcontractor warrants the work performed for a period of _____ months from the date of Substantial Completion, except as follows:_____

ATTEST (If Corporation)

_____
Name of Subcontractor

_____
Secretary (By) (Title)

JURAT

STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20____.

_____
(Seal) (Notary Public Signature)

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Final completion procedures.
   2. Warranties.
   3. Final cleaning.
   4. Repair of the Work.

1.3 SUBMITTALS

A. Certified List of Incomplete Items (Punchlist): Final submittal at Final Completion.

B. Certificates of Release: From authorities having jurisdiction.

C. Certificate of Insurance: For continuing coverage.

D. Field Report: For pest control inspection.

E. List of Extra Materials.

1.4 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
   1. Submit a final Application for Payment in accordance with the Contract Documents.
   2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
   4. Submit pest-control final inspection report.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
   1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
   1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.

2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
   a. Project name.
   b. Date.
   c. Name of Architect.
   d. Name of Contractor.
   e. Page number.

4. Submit list of incomplete items in a PDF electronic file. Architect will return annotated file.

1.6 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
   1. Bind warranties and bonds in heavy duty, three ring, loose leaf binders, thickness necessary to accommodate contents, and sized to receive 8-1/2 inch by 11 inch (215 mm by 280 mm) paper.
   2. Provide heavy paper dividers with plastic covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
   3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
   4. Warranty Electronic File: In addition to the Warranty Binder, scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project. Cleaning activites include but are not limited to:
   a. Clean site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
   b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and foreign deposits.
   c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
   d. Remove tools, construction equipment, machinery, and surplus material from Project site.
   e. Remove snow and ice to provide safe access to building.
   f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
   g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
   h. Sweep concrete floors broom clean in unoccupied spaces.
   i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
   j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
   k. Remove labels that are not permanent.
   l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
   m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
   n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
   o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
      1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
   p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
   q. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 01 50 00. Prepare written report.

D. Construction Waste Disposal: Comply with waste disposal requirements.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
   1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.

2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
   a. Do not paint over *UL* and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 01 77 00

SECTION 01 77 22 – SUBSTANTIAL COMPLETION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Substantial Completion procedures.

1.3 SUBMITTALS

A. Contractor's List of Incomplete Items (Punchlist): Initial submittal at Substantial Completion.

1.4 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Minimum of 10 days prior to requesting an inspection for determining date of Substantial Completion. List items that are incomplete at time of request.
   1. Certificates of Release: Obtain and submit releases from all (i.e. city, county, authorities) authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   2. Submit closeout submittals, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
   3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
      a. List of Extra Materials: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
   5. Submit test/adjust/balance records from Owner vendor.
   6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: A minimum of 10 days prior to requesting inspection for determining date of Substantial Completion, submit list items that are incomplete at time of request.
   1. Advise Owner of pending insurance changeover requirements.
   2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
   3. Complete startup and testing of systems and equipment.
   4. Perform preventive maintenance on equipment used prior to Substantial Completion.

5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings as applicable.
6. Advise Owner of changeover in heat and utilities.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from site, including mockups, construction tools, and similar elements and restore or configure area to required or original condition.
9. Complete final cleaning requirements, including touchup painting.
10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
11. Conditional lien regulations.

D. Inspection: Submit written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
   1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

   2. Results of completed inspection will form the basis of requirements for final completion.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
   1. Complete cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project. Cleaning activites include but are not limited to:
      a. Clean site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
      b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and foreign deposits.
      c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
      d. Remove tools, construction equipment, machinery, and surplus material from Project site.
      e. Remove snow and ice to provide safe access to building.
      f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
      g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
      h. Sweep concrete floors broom clean in unoccupied spaces.

i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.

j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, **taking care not to scratch surfaces.**

k. **Remove labels that are not p**ermanent.

l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.

p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.

q. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 01 50 00. Prepare written report.

D. Construction Waste Disposal: Comply with waste disposal requirements.

END OF SECTION 01 77 22

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
   1. Operation and maintenance documentation directory manuals.
   2. Emergency manuals.
   3. Systems and equipment operation manuals.
   4. Systems and equipment maintenance manuals.
   5. Product maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
   1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
   2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:
   1. Submit on digital media acceptable to Architect or by uploading to web-based project software site or by email to Architect. Enable reviewer comments on draft submittals.
   2. Submit three paper copies. Architect**,** will return two copies.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
   1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

E. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
   1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.

   2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
   1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
      a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
      b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

   2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
   3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
   4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
   5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
      a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
      b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
   1. Title page.
   2. Table of contents.
   3. Manual contents.

B. Title Page: Include the following information:
   1. Subject matter included in manual.

2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.

10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
2. Flood.

3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:
1. Startup procedures.

2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.

2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of maintenance manuals.

1.11 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:
1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.

4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 23

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements for project record documents, including but not limited to:
   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.
   4. Miscellaneous record submittals.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings:
   1. Number of Copies: Submit one set of marked up record prints.
   2. Number of Copies: Submit copies of record Drawings:
      a. Initial Submittal:
         1) Submit PDF electronic files of scanned record prints and one of file prints.
         2) Submit record digital data files and one sets of plots.
         3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
      b. Final Submittal:
         1) Submit PDF electronic files of scanned record prints and three sets of prints.
         2) Submit record digital data files and three sets of record digital data file plots.
         3) Plot each drawing file, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one paper copy and one annotated PDF electronic file of the Project Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one paper copy and one annotated PDF electronic file and directory of each submittal.
   1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked up Product Data as a component of manual.

D. Miscellaneous Record Submittals: Refer to the individual Specification Sections for miscellaneous record keeping requirements and submittals in connection with various construction activities. Submit one paper copy and annotated PDF electronic files and directories of each submittal.

E. Reports: Submit written report monthly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 PROJECT RECORD DOCUMENT PROCEDURES

A. Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference.
   1. Do not use As Built Drawings and Specifications for Record Drawings and Specifications.

B. Recording Procedures: Update drawings and specifications on daily bases to record actual conditions. Record information concurrently with construction progress. Do not conceal Work until required information is accurately recorded.

C. Store Record Documents and samples apart from as built documents used for construction.
   1. Label and file Record Documents and samples in accordance with section number listings in Table of Contents. Label each document *PROJECT RECORD* in neat, large, printed letters.
   2. Maintain Record Documents in clean, dry and legible condition.
   3. Make Record Documents and samples available for inspection upon request of Architect.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked up paper copies of the Contract Drawings and Shop Drawings.
   1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked up record prints. Show actual installation conditions where installation varies from that shown originally.
      a. Give attention to information on concealed elements difficult to identify or measure and record later.
      b. Accurately record information in an acceptable drawing technique.
      c. Record data as soon as possible after obtaining it.
      d. Record and check the markup before enclosing concealed installations.
      e. Cross reference record prints to corresponding shop drawings or archive photographic documentation.

   2. Content: Types of items requiring marking include, but are not limited to, the following:
      a. Dimensional changes to Drawings.
      b. Revisions to details shown on Drawings.
      c. Depths of foundations below first floor.
      d. Locations and depths of underground utilities.
      e. Revisions to routing of piping and conduits.
      f. Revisions to electrical circuitry.
      g. Actual equipment locations.
      h. Duct size and routing.
      i. Locations of concealed internal utilities.
      j. Changes made by Change Order or Construction Change Directive.
      k. Changes made following Architect's written orders.
      l. Details not on the original Contract Drawings.
      m. Field records for variable and concealed conditions.
      n. Record information on the Work that is shown only schematically.

   3. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked up record prints.
   4. Mark record sets with erasable, red colored pencil. Use colors to distinguish between changes for different categories of the Work at same location.
   5. Mark important additional information that was either shown schematically or omitted from original Drawings.
   6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked up record prints with Architect. When authorized, prepare full set of corrected digital data files of the Contract Drawings:
   1. Format: Same digital data software program, version, and operating system as the original Contract Drawings and annotated PDF electronic file with comment function enabled.
   2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
   3. Refer instances of uncertainty to Architect for resolution.
   4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
      a. Refer to Section 01 33 00 for requirements related to use of Architect's digital data files.
      b. Architect will provide data file layer information. Record markups in separate layers.

C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
   1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or modification.

   2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

D. Format: Identify and date each record Drawing; include the designation *PROJECT RECORD DRAWING* in a prominent location.
   1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
   2. Format: Annotated PDF electronic file with comment function enabled.
   3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
   4. Identification: As follows:
      a. Project name.
      b. Date.
      c. Designation PROJECT RECORD DRAWINGS.
      d. Name of Architect.
      e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications. Indicate actual product installation where installation varies from that indicated in Specifications.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
   3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
   4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.

5. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file and marked up paper copy of Specifications.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as annotated PDF electronic file. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.4 RECORD SAMPLES

A. Record Samples: Determine with Architect and Owner which submitted Samples are to be maintained as Record Samples. Maintain and mark one set to indicate date of review and approval by Architect; note any deviations or variations between reviewed sample and installed product or material.

2.5 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by the individual Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference. Include the following:
1. Reviewed shop drawings, product data, and samples.
2. Field test reports.
3. Inspection certificates and manufacturer's certificates.
4. Inspections by authorities having jurisdiction (AHJ).
5. Documentation of foundation depths.
6. Special measurements or adjustments.
7. Tests and inspections.
8. Surveys.
9. Design mixes.

B. Format: Submit miscellaneous record submittals as scanned PDF electronic file(s) of marked up miscellaneous record submittals. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration and training video recordings.
4. O&M Manuals should be uploaded into Owner’s designated software (Prolog)

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules utilizing manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Qualification Data: For instructor.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:
   a. Name of Project.
   b. Name and address of videographer.
   c. Name of Architect.
   d. Name of Contractor.
   e. Date of video recording.

2. At completion of training, submit complete training manual(s) for Owner's use.

1.5 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
   a. System, subsystem, and equipment descriptions.
   b. Performance and design criteria if Contractor is delegated design responsibility.
   c. Operating standards.
   d. Regulatory requirements.
   e. Equipment function.
   f. Operating characteristics.
   g. Limiting conditions.
   h. Performance curves.

2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project record documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.

e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.

7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.

8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."
B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Owner will furnish an instructor to describe Owner's operational philosophy.
2. Owner will furnish Contractor with names and positions of participants.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner through Program Manager with at least 10 days' advance notice.

C. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Architect.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

END OF SECTION 01 79 00

SECTION 02050

DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Demolition of designated site structures, retaining walls, foundations and removal of materials from site.

B. Demolition and removal of pavements, curbs and gutters, drainage structures, utilities, signage or landscaping.

C. Disconnecting and capping or removal of identified utilities.

D. Filling or removal of underground tanks and piping.

E. Filling voids in subgrade created as a result of removals or demolition.

F. Hazardous Material Compliance.

1.02 RELATED SECTIONS

A. Section 02100 - Site Preparation: Clearing outside periphery of structures.

B. Section 02227 - Aggregate Materials: Backfill materials.

C. Construction drawings.

1.03 PROJECT RECORD DOCUMENTS

Accurately record actual locations of capped utilities, and subsurface obstructions.

1.04 REGULATORY REQUIREMENTS

A. Conform to applicable local code for demolition of structures, safety of adjacent structures, dust control and runoff control.

B. Obtain required permits and licenses from authorities. Pay associated fees including disposal charges.

C. Notify affected utility companies before starting work and comply with their requirements.

D. Do not close or obstruct roadways, sidewalks or hydrants without permits.

E. Conform to applicable regulatory procedures when discovering hazardous or contaminated materials.

F. Test soils around buried tanks for contamination.

1.05 JOB CONDITIONS

A. Structures to be demolished will be discontinued in use and vacated prior to start of work.

B. Owner assumes no responsibility for condition of structures to be demolished.

C. Conditions existing at time of inspection for bidding purposes will be maintained by Owner in so far as practicable. Variations within structures may occur by Owner's removal and salvage operations prior to start of demolition work.

D. Unless otherwise indicated in the Construction Documents or specified by the Owner's representative, all items of salvageable value to Contractor shall be removed from the site and structure. Storage or sale of removed items on site will not be permitted and shall not interfere with any other work specified in the contract documents.

E. Explosives shall not be brought to site or used without written consent of authorities having jurisdiction. Such written consent will not relieve Contractor of total responsibility for injury to persons or for damage to property due to blasting operations. The performance of any required blasting shall comply with governing regulations.

PART 2 PRODUCTS

2.01 FILL MATERIALS

Aggregate materials specified in Section 02050.

PART 3 EXECUTION

3.01 PREPARATION

A. Provide, erect, and maintain erosion control devices, temporary barriers and security devices at locations indicated

B. Protect existing landscaping materials, appurtenances and structures which are not to be demolished. Repair damage caused by demolition operations at not cost to Owner.

C. Prevent movement or settlement of adjacent structures. Provide bracing and shoring.

D. Mark location of utilities. Protect and maintain in safe and operable condition the utilities to remain. Prevent interruption of existing utility service to occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities as acceptable to governing authorities and the Owner's representative.

3.02 DEMOLITION REQUIREMENTS

A. Conduct demolition to minimize interference with adjacent structures or pavements.

B. Cease operations immediately if adjacent structures appear to be in danger. Notify authority having jurisdiction. Do not resume operations until directed.

C. Conduct operations with minimum interference to public or private access. Maintain access and egress at all times.

D. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon or limit access to their property.

E. Sprinkle Work with water to minimize dust. Provide hoses and water connections for this purpose.

F. Comply with governing regulations pertaining to environmental protection.

G. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing prior to start of work.

3.03 DEMOLITION

A. Demolish buildings completely and remove from site using methods as required to complete work within limitations of governing regulations. Small structures may be removed intact when acceptable to owner and authorities having jurisdiction.

B. Proceed with demolition in systematic manner, from top of structure to ground and complete demolition work above each floor or tier before disturbing supporting members on lower levels.

C. Locate demolition equipment and remove materials so as to prevent excessive loading to supporting walls, floors, or framing.

D. Remove structural framing members and lower to ground by hoists, derricks, or other suitable methods.

E. Demolish concrete and masonry in small sections. Break up concrete slabs-on-grade that are 2 or more feet below proposed subgrade. Remove slabs within 2 feet of proposed subgrade.

F. Demolish and remove below grade construction and concrete slabs on grade to a minimum depth of two feet below proposed subgrade.

3.04 FILLING BASEMENTS AND VOIDS

A. Completely fill below grade areas and voids resulting from demolition or removal of structures (underground fuel storage tanks, wells, cisterns, etc.) using approved select fill materials consisting of stone, gravel, and sand free from debris, trash, frozen materials, roots, and other organic matter.

B. Ensure that areas to be filled are free of standing water, frost, frozen, or unsuitable material, trash, and debris prior to fill placement.

C. Place fill materials in horizontal layers not exceeding 8" in loose depth and compact each layer at optimum moisture content of fill material to proposed density, unless subsequent excavation for new work is required.

D. Grade surface to match adjacent grades and to provide flow of surface drainage after fill placement and compaction.

3.05 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove from site debris, rubbish, and other materials resulting from demolition operations.

B. No burning of any material, debris, or trash on-site or off-site will be allowed, except when allowed by the appropriate governing authority and the Owner's representative. If allowed as stated above, burning shall be performed in manner prescribed by governing authority. Attend burning materials until fires have burned out or have been extinguished.

C. Transport materials removed from demolished structures with appropriate vehicles and dispose off-site to areas which are approved for disposal by governing authorities and appropriate property owners.

END OF SECTION 02050

SECTION 02100

SITE PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES:

A. Cleaning site of debris, grass, trees and other plant life in preparation for site or building excavation work.

B. Protection of existing structures, trees or vegetation indicated on the contract documents to remain.

C. Stripping topsoil from areas that are to be incorporated into the limits of the project and where so indicated on the construction drawings.

1.02 RELATED SECTIONS

A. Section 02050 - Demolition

B. Section 02200 - Earthwork

C. Section 02270 - Slope Protection and Erosion Control

D. Construction Drawings

1.03 ENVIRONMENTAL REQUIREMENTS

A. Construct temporary erosion control systems as shown on the plans or as directed by the engineer to protect adjacent properties and water resources from erosion and sedimentation.

B. In the event that site work on this project will disturb five (5) or more acres, the contractor shall **NOT** begin construction without a "National Pollution Discharge Elimination System" (NPDES) permit governing the discharge of storm water from the construction site for the entire construction period. The permit requires a "Storm Water Pollution Prevention Plan" (SWP) to be in place during construction which includes monitoring of storm water flows during construction.

The contractor shall be totally responsible for conducting the storm water management practices in accordance with the NPDES permit and for any enforcement action taken or imposed by Federal or State agencies, including the cost of fines, construction delays and remedial actions resulting from the contractors failure to comply with all provisions of the NPDES permit.

1.04 JOB CONDITIONS

A. Conditions existing at time of inspection for bidding purposes will be maintained by owner in so far as practical.

B. Variations to conditions or discrepancy in actual conditions as they apply to site preparation operations are to be brought to the attention of the owner prior to the commencement of any site work.

PART 2 PRODUCTS

Not applicable.

PART 3 EXECUTION

3.01 PREPARATION

Verify that existing plant life and clearing limits are clearly tagged, identified and marked in such a manner as to insure their safety throughout construction operations.

3.02 PROTECTION

A. Locate and identify existing utilities that are to remain and protect them from damage.

B. Protect trees, plant growth and features designated to remain as final landscape.

C. Conduct operations with minimum interference to public or private accesses and facilities. Maintain access and egress at all times and clean or sweep any roadways daily or as required by the governing authority. At such times as deemed necessary by the owner, dust control shall be provided with sprinkling systems or equipment provided by the contractor.

D. Protect bench marks, property corners and all other survey monuments from damage or displacement. If a marker needs to be removed it shall be referenced by a licensed land surveyor and replaced, as necessary, by the same.

E . Provide traffic control as required, in accordance with the U.S. Department of Transportation "Manual of Uniform Traffic Control Devices" and the state highway department requirements.

3.03 CLEARING

A. Clear areas required for access to site and execution of work.

B. Unless otherwise indicated on the drawings, remove trees, shrubs, grass, other vegetation, improvements, or obstructions interfering with installation of new construction. Removal includes digging out stumps and roots. Depressions caused by clearing and grubbing operations are to be filled to subgrade elevation to avoid water ponding. Satisfactory fill material shall be placed in horizontal layers not exceeding 8" loose depth, and thoroughly compacted per fill requirements of this section and Section 02200.

C. Remove grass, trees, plant life, stumps and all other construction debris from the site to a dump site that is suitable for handling such material according to state laws and regulations.

3.04 TOPSOIL EXCAVATION

A. Strip topsoil from areas that are to be filled, excavated, landscaped or re-graded to such a depth that it prevents intermingling with underlying subsoil or questionable material.

B. Cut heavy growths of grass from areas before stripping and remove with the rest of the cleared vegetative material.

C. Topsoil shall consist of organic surficial soil found in depth of not less than 6". Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones and other objects over 2" in diameter, weeds, roots, and other objectionable material.

D. Stockpile topsoil in storage piles in areas shown or where directed. Construct storage piles to freely drain surface water. Cover storage piles as required to prevent windblown dust. Dispose of unsuitable topsoil as specified for waste material, unless otherwise specified by owner. Excess topsoil shall be removed from the site by the Contractor unless specifically noted otherwise on the Drawings.

END OF SECTION 02100

SECTION 2200

EARTHWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Protection, modification and/or installation of utilities as sitework progresses paying particular attention to grade changes and any necessary staging of work.

B. Cutting, filling and grading to required lines, dimensions, contours and proposed elevations for proposed improvements.

C. Scarifying, compaction, drying and removal of unsuitable material to ensure proper preparation of areas for fills or proposed improvements.

1.02 RELATED SECTIONS

A. Section 02050 - Demolition

B. Section 02100 - Site Preparation

C. Section 02221 - Excavation, Backfill and Compaction for Structures

D. Section 02222 - Excavation, Backfill and Compaction for Utilities

E. Section 02223 - Excavation, Backfill and Compaction for Pavement

F. Section 02227 - Aggregate Materials

G. Section 02229 - Rock Removal

H. Section 02245 - Soil Stabilization

I. Section 02900 - Landscaping

J. Geotechnical Report (if available) for boring locations and findings of subsurface materials and conditions.

K. Construction Drawings

L. Architectural Plans and Specifications as they relate specifically to the earthwork beneath the buildings, where the architectural requirements are more stringent than the civil requirements

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM) latest edition.

D 422	Method for Particle Size Analysis of Soils
D 698	Test for Moisture-Density Relations of Soils Using 5.5 lb. (2.5 kg) Rammer and 12-inch (304.8 mm) Drop (Standard Proctor)
D 1556	Test for Density of soil in Place by the Sand Cone method
D 1557	Test for Moisture-Density Relations of Soils Using 10-lb (4.5 Kg) Rammer and 18-inch (457 mm) Drop (Modified Proctor)

D 1559	Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
D 2167	Test for Density of Soil in Place by the Rubber Balloon Method
D 2216	Laboratory Determination of Moisture content of Soil
D 2487	Classification of Soils for Engineering Purposes
D 2922	Tests for Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth)
D 3017	Test for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
D 4318	Test for Plastic Limit, Liquid Limit, and Plasticity Index of Soils
C 25	Chemical Analysis of Limestone, Quicklime and Hydrate Lime
C110	Physical Testing for Quicklime and Hydrated Lime, Wet Sieve Method
C618	Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
C977	Quicklime and Hydrated Lime for Soil Stabilization

B. American Association of State Highway and Transportation Officials (AASHTO) latest edition
T88 Mechanical Analysis of Soils

1.04 QUALITY ASSURANCE

A. Independent Testing Laboratory selected and paid by owner, shall be retained to perform construction testing on site based on the following:

1. Building Subgrade Areas, <u>including</u> 10' –0" Outside Exterior Building Lines: In cut areas, not less than one compaction test for every 2,500 square feet. In fill areas, same rate of testing for each 8" lift (measured loose).

2. Areas of Construction <u>exclusive</u> of building subgrade: In cut areas, not less than one compaction test for every 10,000 square feet. In fill areas, same rate of testing for each 8" lift (measured loose).

B. If compaction requirements are not complied with at any time during construction process, remove and recompact deficient areas until proper compaction is obtained at <u>no</u> additional expense to owner.

C. In all areas to receive pavement, a CBR (or LBR) test shall be performed for each type of material imported from off-site.

D. The following tests shall be performed on each type of on-site or imported soil material used as compacted fill as part of construction testing requirements.

1. Moisture and Density Relationship: ASTM D 698 or ASTM D1557.

2. Mechanical Analysis: AASHTO T-88

3. Plasticity Index: ASTM D 4318

E. Field density tests for in-place materials shall be performed according to one of the following standards as part of construction testing requirements.

1. Sand-Cone Method: ASTM D 1556

2. Balloon Method: ASTM D 2167

3. Nuclear method: ASTM D 2922 (Method B-Direct Transmission)

F. Independent Testing Laboratory shall prepare test reports that indicate test location, elevation data, and test results. Owner, architect, and contractor shall be provided with copies of reports within 96 hours of time test was performed. In event that any test performed fails to meet these Specifications, owner and contractor shall be notified immediately by independent testing laboratory.

G. All costs related to retesting due to failures shall be paid for by the contractor at no additional expense to owner. Owner reserves the right to employ an Independent Testing Laboratory and to direct any testing that is deemed necessary. Contractor shall provide free access to site for testing activities.

1.05 SUBMITTALS

A. Submit a sample of each type of off-site fill materials that is to be used at the site in an air tight, 10 lb container for the testing laboratory.

B. Submit the name of each material supplier and specific type and source of each material. Any change in source throughout the job requires approval of the owner or engineer.

C. For use of fabrics or geogrids, a design shall be submitted for approval by the Owner.

PART 2 PRODUCTS

2.01 MATERIALS

A. Excavated and re-used material for subsoil fill as specified herein.

B. Aggregate fill as specified in Section 02227.

C. Imported subsoil material approved by the owner and specified herein.

D. Topsoil fill as specified in Section 02100.

E. Acceptable stabilization fabrics and Geogrids:

1. Mirafi 50OX or 60OX

2. Phillips 66 Supac 6WS

3. Dupont Typar 3401 and 3601

4. Trevira S1114 and S1120

5. Tensar SS-1 and SS-2

6. Exxon GTF-200 or 350

F. Filter/Drainage Fabrics

1. Mirafi 14ONS

2. Phillips 66 Supac 4NP

3. Dupont Typar 3341

PART 3 EXECUTION

3.01 PREPARATION

A. Identify required lines, levels, contours and datum.

B. Locate and identify existing utilities that are to remain and protect them from damage.

C. Notify utility companies to remove and/or relocate any utilities that are in conflict with the proposed improvements.

D. Protect plant life, lawns, fences, existing structures, sidewalks, paving and curbs from excavating equipment and vehicular traffic.

E. Protect benchmarks, property corners and all other survey monuments from damage or displacement. If a marker needs to be removed it shall be referenced by a licensed land surveyor and replaced, as necessary, by the same.

F. Remove from site material encountered in grading operations that, in opinion of owner or owners representative, is unsuitable or undesirable for backfilling, subgrade or foundation purposes. Dispose of in a manner satisfactory to owner. Backfill areas with layers of suitable material and compact as specified.

G. Prior to placing fill in low areas, such as previously existing creeks, ponds, or lakes, perform following procedures:

1. Drain water out by gravity with ditch having flow line lower than lowest elevation in low area. If drainage cannot be performed by gravity ditch, use adequate pump to obtain same results.

2. After drainage of low area is complete, remove mulch, mud, debris, and other unsuitable material by using acceptable equipment and methods that will keep natural soils underlying low areas dry and undisturbed.

3. If proposed for fill, all muck, mud, and other materials removed from above low areas shall be dried on-site by spreading in thin layers for observation by owner or owner's representative. Material shall be inspected and, if found to be suitable for use as fill material, shall be incorporated into lowest elevation of site filling operation, but not under the building area or within lo' -oll of perimeter of building pad or paving subgrade. If, after observation by owner or owners representative, material is found to be unsuitable, all unsuitable material shall be removed from site.

3.02 EXCAVATION FOR FILLING AND GRADING

A. Classification of Excavation: Contractor by submitting bid acknowledges that he has investigated the site to determine type, quantity, quality, and character of excavation work to be performed. Excavation shall be considered unclassified excavation, except as indicated by "Article 4 - Administration of the Contract" in the "Supplementary Conditions" portion of the specification.

B. Perform excavation using capable, well maintained equipment and methods acceptable to owner and governing agencies.

C. When performing grading operations during periods of wet weather, provide adequate drainage and ground water management to control moisture of soils.

D. Shore, brace, and drain excavations as necessary to maintain safe, secure, and free of water at all times.

E. Excavated material containing rock or stone greater than 6" in largest dimension is unacceptable as fill to within the proposed building and paving area.

F. Rock or stone less than 6" in largest dimension is acceptable as fill to within 24" of surface of proposed subgrade when mixed with suitable material.

G. Rock or stone less than 2" in largest dimension and mixed with suitable material is acceptable as fill within the upper 24" of proposed subgrade.

3.03 FILLING AND SUBGRADE PREPARATION

A. Fill areas to contours and elevations shown with unfrozen materials.

B. Place fill in continuous lifts specified herein.

C. Refer to Section 02221 for filling requirements for structures.

D. Refer to Section 02223 for filling requirements for pavements.

E. Areas exposed by excavation or stripping and on which subgrade preparations are to be performed shall be scarified to minimum depth of 8" and compacted to minimum of 95% of optimum density, in accordance with ASTM D 698 (or 92% of optimum density, in accordance with ASTM D 1557), at a moisture content of not less than l% below and not more than 3% above the optimum moisture content. These areas shall then be proofrolled to detect any areas of insufficient compaction. Proofrolling shall be accomplished by making a minimum of two (2) complete passes with a fully-loaded tandem-axle dump truck, or approved equivalent, in each of the two perpendicular directions under the supervision and direction of a field geotechnical engineer. Areas of failure shall be excavated and recompacted as stated above.

F. Fill materials used in preparation of subgrade shall be placed in lifts or layers not to exceed 8" loose measure and compacted to a minimum density of 95% of optimum density, in accordance with ASTM D 698, (or 92% of the optimum density, in accordance with ASTM D 1557) at a moisture content of not less than it below and not more than 3% above the optimum moisture content.

G. Material imported from off-site shall have a CBR (California Bearing Ratio) or LBR (Limerock Bearing Ratio) value equal to or above the pavement design subgrade CBR or LBR value indicated on the Drawings.

3.04 MAINTENANCE OF SUBGRADE

A. Finished subgrades shall be verified to ensure proper elevation and conditions for construction above subgrade.

B. Protect subgrade from excessive wheel loading during construction, including concrete trucks and dump trucks.

C. Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in a manner that will comply with compaction requirements by use of material equal to or better than best subgrade material on site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section.

3.05 RIP RAP

A. Place rip-rap in all areas where indicated on the Drawings. The stone for rip-rap shall consists of field stone or rough unhewn quarry stone as nearly uniform, in section as is practical. The stones shall be dense, resistant to the action of air and water, and suitable in all aspects for the purpose intended. Unless otherwise specified, all stones used as rip-rap shall weigh between 50 and 150 pounds each, and at least 60 percent of the stones shall weigh more than 100 pounds each.

B. Slopes and other areas to be protected shall be dressed to the line and grade shown on the plans prior to the placing of rip-rap. Contractor shall undercut the areas to receive rip-rap to an elevation equal to the final elevation less the average diameter of the stones before placing the rip-rap.

C. Filter fabric and bedding stone shall be installed prior to the placement of the stones if so indicated on the drawings. The bedding stone shall be quarried and crushed angular limestone in accordance with Section 02227 and shall be 6" in depth. Filter fabric shall be as specified herein and as detailed on the plans.

D. Stones shall be placed so that the greater portion of their weight is carried by the earth and not by the adjacent stones. The stones shall be placed in a single layer with close joints. The upright areas of the stone shall make an angle of approximately 90 degree with the embankment slope. The courses shall be placed from the bottom of the embankment upward, the larger stones being placed in the lower courses. Open joints shall be filled with spalls. Stones shall be embedded in the embankment as necessary to present a uniform top surface such that the variation between tops of adjacent stones shall not exceed three inches.

3.06 FINISH GRADING

A. Grade all areas where finish grade elevations or contours are indicated on Drawings, other than paved areas and buildings, including excavated areas, filled and transition areas, and landscaped areas. Graded areas shall be uniform and smooth, free from rock, debris, or irregular surface changes. Finished subgrade surface shall not be more than 0.10 feet above or below established finished subgrade elevation, and all ground surfaces shall vary uniformly between indicated elevations. Finish ditches

shall be graded to allow for proper drainage without ponding and in a manner that will minimize erosion potential. For topsoil application, refer to Section 02900 Landscaping.

B. Correct all settlement and eroded areas within one year after date of completion at no additional expense to owner. Bring grades to proper elevation. Replant or replace any grass, shrubs, bushes, or other vegetation that appears dead, dying or disturbed by construction activities. Refer to Section 02270 for slope protection and erosion control.

C. Refer to Section 02245 for soil stabilization using lime, cement, fly ash and geotextile fabric methods for subbase materials.

3.07 ROCK EXCAVATION (See Section 02229 Rock Removal)

END OF SECTION 02200

SECTION 02221

EXCAVATION, BACKFILLING AND COMPACTING FOR STRUCTURE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavate to line, grade and configuration as shown in the plans and specifications for proposed structures and expansion areas.

B. Fill to line, grade and configuration as shown in the plans and specifications for proposed structures and expansion areas.

C. Compacting for materials in an acceptable manner as stated herein.

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Section 02227 - Aggregate material

C. Section 02229 - Rock Removal

D. Section 02245 - Soil Stabilization

E. Section 02511 - Asphaltic Concrete Paving

F. Section 02520 - Portland Cement Concrete Paving

G. Geotechnical report (if available) for boring locations and findings of subsurface materials and conditions.

H. Construction drawings.

I. Architectural plans and specifications as they relate specifically to earthwork beneath the buildings, where the architectural requirements are more stringent than the civil requirements.

1.03 REFERENCE STANDARDS

A. American society for testing and materials (ASTM) latest edition.
- D 422 Method for particle size analysis of soils.
- D 698 Test for moisture-density relations of soils using 5.5 lb. (2.5 kg) Rammer and 12 inch (304.8 mm) drop (Standard Proctor).
- D 1556 Test for density of soil in place by the sand cone method.
- D 1557 Test for moisture-density relations of soils using 10-lb (4.5 kg) Rammer and 18-inch (457 mm) drop (Modified Proctor).
- D 1559 Test method for resistance to plastic flow of bituminous mixtures using Marshall Apparatus.
- D 2167 Test for density of soil in place by the Rubber Balloon Method.
- D 2216 Laboratory determination of moisture content of soil.
- D 2487 Classification of soils for engineering purposes.
- D 2922 Tests for density of soil and soil-aggregate in place by nuclear methods (shallow depth).
- D 3017 Test for moisture content of soil and soil aggregate in place by nuclear methods (shallow depth).

D4318 Test for plastic limit, liquid limit, & plasticity index of soils.
C25 Chemical analysis of limestone, quicktime and hydrated lime.
C110 Physical testing for quicklime and hydrated lime, wet sieve method.
C618 Specification for fly ash and raw or calcined natural pozzolan for use as a mineral admixture in Portland cement concrete.
C977 Quicklime and hydrated lime for soil stabilization.

A. American Association of State Highway and Transportation Officials (AASHTO) latest edition.

T88 Mechanical Anaylsis of Soils.

1.04 QUALITY ASSURANCE

Independent testing laboratory selected and paid by owner shall be retained to perform construction testing on filling operations and subgrade analysis as specified in Section 02200 and as stated herein.

1.05 SUBMITTALS

A. Shop drawings or details pertaining to excavating and filling for structures are not required unless otherwise shown on the drawings or specifications or if contrary procedures to the project documents are proposed.

B. Submit a sample of each type of off-site fill material that is to be used in backfilling in an air-tight, 10 lb. container for the testing laboratory or submit a gradation and certification of the aggregate material that is to be used to the testing laboratory for review.

PART 2 PRODUCTS

2.01 MATERIALS

A. Fill material from on-site as specified in Section 02200 and approved by the owner or owner's representative.

B. Fill material from off-site as specified in Section 02200 and approved by the owner or owner's representative.

C. Aggregate material as specified in Section 02227.

PART 3 EXCAVATION

3.01 PREPARATION

A. Identify all lines, elevations and grades necessary to construct building subgrades as shown in the plans and specifications.

B. Carefully protect benchmarks, property corners, monuments or other reference points.

C. Locate and identify all site utilities that have previously been installed and may be in danger of damage by grading operations.

D. Locate and identify all existing utilities that are to remain and protect them from damage.

E. Over excavate and properly prepare areas of subgrade that are not capable of supporting the proposed systems. These areas shall be stabilized by using acceptable filter fabrics and/or aggregate materials placed and compacted as specified.

3.02 EXCAVATION

A. Excavate building areas to line and grade as shown in the plans and specifications being careful not to over excavate beyond the elevations needed for building subgrades.

B. Engage all suitable material into the project fill areas as specified in Section 02200.

C. Unsuitable excavated material is to be disposed of in a manner and location that is acceptable to the owner and local governing agencies.

D. Perform excavation using capable, well maintained equipment and methods acceptable to the owner and the project document requirements.

3.03 FILLING AND SUBGRADE PREPARATION

A. Building area subgrade pad shall be that portion of site directly beneath and ten feet (10') beyond the building and appurtenances including the limits of any future building expansion areas as shown on the civil site drawings.

B. The building area subgrade pad shall be prepared in strict accordance with the "foundation subsurface preparation" as shown on the civil-site drawings and/or the architectural-structural drawings whichever is more stringent. Rock larger than six inches (6") shall not be part of building subgrade fill.

C. Areas exposed by excavation or stripping and on which building subgrade preparations are to performed shall be scarified to a minimum depth of 8" and compacted to a minimum of 95% of the optimum density, in accordance with ASTM D 698, (or 92% of the optimum density, in accordance with ASTM D1557) at a moisture content of not less than l% below and not more than 3% above the optimum moisture content. These areas shall then be proofrolled to detect any areas of insufficient compaction. Proofrolling shall be accomplished by making a minimum of two (2) complete passes with a fully-loaded tandem-axle dump truck, or approved equivalent, in each of the two perpendicular directions under the supervision and direction of a field geotechnical engineer. Areas of failure shall be excavated and recompacted as stated above.

D. Fill materials used in preparation-of building subgrade shall be placed in lifts or layers not to exceed 8" loose measure and compacted to a minimum density of 95% of optimum density, in accordance with ASTM D 698 (or 92% of the optimum density, in accordance with ASTM D 1557), at a moisture content of not less than it below and not more than 3% above the optimum moisture content. Unless specifically stated otherwise in the "foundation subsurface preparation" on the Drawings, the following table stipulates maximum allowable values for plasticity index (PI) and liquid limit (LL) of suitable materials to be used as fill in the specified areas:

*Building area, below upper four feet	20	50
*Building area, upper four feet	12	40

(*References to depth are to proposed subgrade elevations)

3.04 COMPACTION

A. Maintain optimum moisture content of fill materials to attain required compaction density.

B. All materials shall be tested in accordance with Section 02200.

C. An independent testing laboratory selected and paid by the owner, shall be retained to perform testing on site.

D. Compaction tests will be as specified in Section 02200 together with the following for building subgrade areas including 10'-0" outside exterior building lines:

In cut areas, not less than one compaction test for every 2,500 square feet. In fill areas, same rate of testing for each 8" lift (measured loose).

E. If compaction requirements are not complied with at any time during construction process, remove and recompact deficient areas until proper compaction is obtained at no additional expense to the Owner.

3.05 MAINTENANCE OF SUBGRADE

A. Finished subgrades shall be verified to ensure proper elevation and conditions for construction above subgrade.

B. Protect subgrade from excessive wheel loading during construction, including concrete trucks and dump trucks.

C. Remove areas of finished subgrade found to have insufficient compaction density of depth necessary and replace in a manner that will comply with compaction requirements by use of materials equal to or better than best subgrade material on site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section.

3.06 FINISH GRADING

A. Finish grading shall be in accordance with Section 02200 and as more specifically stated herein.

B. Grading of building areas shall be checked by string line from grade stakes (blue tops) set at not more than 50' centers. Tolerance of 0.10 feet, more or less, will be permitted. Contractor to provide engineering and field staking necessary for verification of lines, grades, and elevations.

3.07 ROCK EXCAVATION (SEE SECTION 02229 ROCK REMOVAL)

END OF SECTION 02221

SECTION 02222

EXCAVATION, BACKFILLING AND COMPACTING FOR UTILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavating trenches for the installation of utilities

B. Backfilling trench with bedding material as specified and indicated and finishing filling trench with suitable material to proposed subgrade.

C. Compacting backfill materials in an acceptable manner

D. Borings and casings under roads

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Section 02227 - Aggregate Materials

C. Section 02229 - Rock Removal

D. Section 02605 - Sewer Structures

E. Section 02660 - Water Distribution Systems

F. Section 02687 - Site Gas Lines

G. Section 02720 - Storm Sewer Systems

H. Section 02730 - Sanitary Sewer Systems

I. Section 02810 - Landscape Irrigation

J. Geotechnical report (if available) for boring locations and findings of subsurface materials and conditions

K. Construction Drawings

1.03 REFERENCE STANDARDS

A. American society for testing and materials (ASTM) Latest Edition
- D 422 Method for Particle Size Analysis
- D 698 Test for Moisture-Density Relations of Soils Using 5.5-lb. (2.5 Kg) Rammer and 12-inch (304.8mm) Drop (Standard Proctor)
- D 1556 Test for Density of Soil in Place by the Sand Cone Method
- D 1557 Test for Moisture-Density Relations of Soils Using 10-lb. (4.5 Kg) Rammer and 18-inch (457 mm) Drop (Modified Proctor)
- D 1559 Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
- D 2216 Laboratory Determination of Moisture Content of Soil
- D 2487 Classification of Soils for Engineering Purposes

D 2922 Tests for Density of Soil and Soil-Aggregate in Place by Nuclear methods (Shallow Depth)

D 3017 Test for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
D 4318 Test for Plastic Limit, Liquid Limit, & Plasticity Index of Soils
C 25 Chemical Analysis of Limestone, Quicklime and Hydrated Lime.
C 110 Physical Testing for Quicklime and Hydrated Lime, Wet Sieve Method
C 618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
C 977 Quicklime and Hydrated Lime for Soil Stabilization

B. American Association of State Highway and Transportation Officials (AASHTO) latest edition
T88 Mechanical Analysis of Soils

1.04 QUALITY ASSURANCE

Independent testing laboratory selected and paid by owner, shall be retained to perform construction testing on backfilling operations as specified in Section 02200 and as stated herein.

1.05 SUBMITTALS

A. Shop Drawings or details pertaining to Site Utilities are not required unless required by regulatory authorities or unless use of materials, methods, equipment, or procedures are contrary to Drawings or these specifications are proposed. Do not perform work until required shop drawings have been accepted by Owner.

B. The Contractor shall contact all utility companies and determine if additional easements will be required to complete the project. Contractor shall provide written confirmation of the status of all easements to the Owner's Construction Manager at the time of the preconstruction conference or no later than 90 days prior to the project possession date.

C. Submit a sample of each type of offsite fill material that is to be used in backfilling in an air-tight, 10 lb container for the testing laboratory or submit a gradation and certification of the aggregate material that is to be used to the testing laboratory for review.

1.06 PROJECT RECORD DOCUMENTS

Accurately record actual locations of all subsurface utilities, structures and obstructions encountered.

PART 2 PRODUCTS

2.01 MATERIALS

A. Bedding Material: Processed sand and gravel free from clay lumps, organic, or other deleterious material, and complying with following gradation requirements:

U. S. Sieve Size	Percent Passing (by weight)
1 Inch	100
3/4 Inch	90-100
3/8 Inch	20- 55
No. 4	0- 10
No. 8	0- 5

B. Backfill material from site as specified in Section 02200 and approved by the owner or owner's representative.

C. Backfill material from offsite as specified in Section 02200 and approved by the owner or owner's representative.

D. Steel Casing Pipe: Comply with AWWA C-201 or C-202, minimum grade B, size and wall thickness as indicated on Drawings.

E. Acceptable Stabilization Fabrics and Geogrids

1. Mirafi 50OX or 60OX
2. Phillips 66 Supac 6WS
3. Dupont Typar 3401 and 3601
4. Trevira S1114 and S1120
5. Tensar SS-1 and SS-2
6. Exxon GTF-200 or 350

F. Filter/Drainage Fabrics

1. Mirafi 140 NS
2. Phillips 66 Supac 4NP
3. Dupont Typar 3341

PART 3 EXECUTION

3.01 PREPARATION

A. Set all lines, elevations, and grades for utility and drainage system work and control system for duration of work, including careful maintenance of bench marks, property corners, monuments, or other reference points.

B. Maintain in operating condition all existing utilities, active utilities and drainage systems encountered in utility installation. Repair any surface or subsurface improvements shown on Drawings.

C. Verify location, size, elevation, and other pertinent data required to make connections to existing utilities and drainage systems as indicated on Drawings. Contractor shall comply with local codes and regulations.

D. Over excavate and properly prepare areas of subgrade that are not capable of supporting the proposed systems. These areas shall be stabilized by using acceptable filter fabrics and/or additional bedding material placed and compacted as specified.

E. Install dewatering systems that will be required to construct the proposed utilities in a manner that is described herein.

3.02 EXCAVATION

A. The local utility companies shall be contacted before excavation shall begin. Dig trench at proper width and depth for laying pipe, conduit, or cable. Cut trench banks vertical if possible and remove stones from bottom of trench as necessary to avoid point-bearing. Over excavate wet or unstable soil, if encountered, from trench bottom as necessary to provide suitable base for continuous and uniform bedding.

B. All trench excavation side walls greater than 5 feet in depth shall be sloped, shored, sheeted, braced or otherwise supported by means of sufficient strength to protect the workmen within them in accordance with the applicable rules and regulations established for construction by the Department of Labor, Occupational Safety and Health Administration (OSHA), and by local ordinances. Lateral travel distance to an exit ladder or steps shall not be greater than 25 feet in trenches 4 feet or deeper.

C. Perform excavation as indicated for specified depths. During excavation, stockpile materials suitable for backfilling in orderly manner far enough from bank of trench to avoid overloading, slides, or cave-ins.

D. Remove excavated materials not required or not suitable for backfill or embankments and waste as specified. Any structures discovered during excavation(s) shall be disposed of as specified.

E. Prevent surface water from flowing into trenches or other excavations by temporary grading or other methods, as required. Remove accumulated water in trenches or other excavations by pumping or other acceptable methods.

F. Open cut excavation with trenching machine or backhoe. Where machines other than ladder or wheel-type trenching machines are used, do not use clods for backfill. Dispose of unsuitable material and provide other suitable material at no additional cost to Owner.

G. Accurately grade trench bottom to provide uniform bearing and support for each section of pipe on bedding material at every point along entire length, except where necessary to excavate for bell holes, proper sealing of pipe joints, or other required connections. Dig bell holes and depressions for joints after trench bottom has been graded. Dig no deeper, longer, or wider than needed to make joint connection properly.

H. Trench width requirements below the top of the pipe shall not be less than 12" nor more than 18", wider than outside surface of any pipe or conduit that is to be installed to designated elevations and grades. All other trench width requirements for pipe, conduit, or cable shall be the least practical width that will allow for proper compaction of trench backfill.

I. Trench depth requirements measured from finished grade or paved surface shall meet the following requirements or applicable codes and ordinances:

1. Water Mains: 30" to top of pipe barrel or 6", below the frost line (established by the local building official), whichever is deeper.

2. Sanitary Sewer: Elevations, and grades as indicated on Drawings.

3. Storm Sewer: Depths, elevations, and grades as shown on Drawings.

4. Electrical Conduits: 24" minimum to top of conduit or as required by NEC 300-5, NEC 710-36 codes, or the local utility company requirements, whichever is deeper.

5. TV Conduits: 18" minimum to top of conduit or as required by the local utility company, whichever is deeper.

6. Telephone Conduits: 18" minimum to top of conduit, or as required by the local utility company, whichever is deeper.

7. Gas Mains and Service: 30" minimum to top of pipe, or as required by the local utility company, whichever is deeper.

J. Provide sheeting and bracing, when necessary, in trenches and other excavations where protection of workmen required. Sheeting may be removed after sufficient backfilling to protect against damaging or injurious caving.

3.03 PIPE BEDDING

A. Accurately cut trenches for pipe or conduit that is installed to designated elevations 4" below bottom of pipe and to width as specified. Place 40 of bedding material, compact in bottom of trench, and accurately shape to conform to lower portion of pipe barrel. After pipe installation, place backfill as specified and compact in maximum 8" layers measured loose to the top of the trench.

B . Place geotextile fctbric as specified on the plans and specifications.

3.04 BACKFILLING

A. Criteria: Trenches shall not be backfilled until required tests are performed and the utility systems comply with and are accepted by applicable governing authorities. Backfill trenches as specified. If improperly backfilled, reopen to depth required to obtain proper compaction. Backfill and compact, as specified, to properly correct condition in an acceptable manner.

B. Backfilling: After pipe or conduit has been installed, bedded, and tested as specified, backfill trench or structure excavation with specified material placed in 8" maximum loose lifts.

C. Backfill trenches to the contours and elevations shown on the plans with unfrozen materials.

D. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.

3.05 COMPACTION

A. Exercise proper caution when compacting immediately over top of pipes or conduits. water jetting or flooding is not permitted as a method of compaction.

B. Maintain optimum moisture content of fill materials to attain required compaction density.

C. An independent testing laboratory shall perform testing at intervals not exceeding 200' of trench for the first and every other eight-inch (8") lift of compacted trench backfill and furnish copies of test results as specified. Compact to minimum density of 95% of optimum density in accordance with ASTM D 699 or 92% of optimum density in accordance with ASTM D1557.

D. All materials used for backfill shall comply with the requirements of Section 02200.

3.06 BORINGS AND CASINGS UNDER ROADS, HIGHWAYS AND RAILROAD CROSSINGS

A. When indicated by Drawings and specifications, all street, road, highway, or railroad crossings for utility mains installed by the jacking and boring method shall be in accordance with area specifications and governing authorities.

B. Excavation of approach pits and trenches within right- of-way of street, road, highway, or railroad shall be of sufficient distance from paving or railroad tracks to permit traffic to pass without interference. Tamp backfill for approach pits and trenches within right - of -way in layers not greater than 6", thick for entire length and depth of trench or pit. Compact backfill to 95% of maximum density obtained at optimum moisture as determined by AASHO T 180-57, Method A. Mechanical tampers may be used after cover of 6" has been obtained over top of barrel of pipe.

C. Accomplish boring operation using commercial type boring rig and hole shall be bored to proper alignment and grade and within 2" of same diameter as largest outside joint diameter of pipe installed. Install pipe in hole immediately after bore has been made, and in no instance shall hole be left open while unattended.

D. In event subsurface operations result in failure or damage to pavement within one year of construction, Contractor shall make necessary repairs to pavement at no additional cost to Owner. In event paving cracks on either side of pipe line or is otherwise disturbed or broken due to construction operations, Contractor shall repair or replace disturbed or broken area at no additional expense to the Owner.

E. Clean and prime interior and exterior of casing pipe; and line with two coats of asphalt in accordance with area specifications and governing authorities.

F. Butt weld steel casing welds shall be full penetration single butt-welds in accordance with AWWA C-205 and AWS D7-0-62.

G. Install casing and utility pipe with end seals, vent pipe, and other special equipment in accordance with area specifications and governing authorities.

3.07 ROCK EXCAVATION (See Section 02229 Rock Removal)

END OF SECTION 02222

SECTION 02223

EXCAVATION, BACKFILLING AND COMPACTING FOR PAVEMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavate to line, grade and configuration as shown in the plans and specifications for proposed and future pavement areas.

B. Fill to line, grade and configuration as shown in the plans and specifications for proposed and future pavement areas.

C. Compacting fill materials in an acceptable manner as stated herein.

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Section 02227 - Aggregate Materials

C. Section 02229 - Rock Removal

D. Section 02245 - Soil Stabilization

E. Section 02505 - Paving Base Course

F. Section 02511 - Asphaltic Concrete Paving

G. Section 02520 - Portland Cement Concrete Paving

H. Section 02525 - Curbs and Sidewalks

I Geotechnical Report (if available) for Boring Locations and Findings of Subsurface Materials and Conditions.

J. Construction Drawings

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM) latest edition.

- D 422 Method for Particle Size Analysis of Soils
- D 698 Test for Moisture-Density Relations of Soils Using 5.5 lb. (2.5 kg) Rammer and 12-inch (304.8 mm) Drop (Standard Proctor)
- D 1556 Test for Density of soil in Place by the Sand Cone Method
- D 1557 Test for Moisture-Density Relations of Soils Using 10-lb (4.5 Kg) Rammer and 18-inch (457 mm) Drop (Modified Proctor)
- D 1559 Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
- D 2167 Test for Density of Soil in Place by the Rubber Balloon Method
- D 2216 Laboratory Determination of Moisture content of Soil
- D 2487 Classification of Soils for Engineering Purposes

D 2922 Tests for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
D 3017 Test for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
D 4318 Test for Plastic Limit, Liquid Limit, and Plasticity Index of Soils
C 25 Chemical Analysis of Limestone, Quicklime and Hydrated Lime
C110 Physical Testing for Quicklime and Hydrated Lime, Wet Sieve Method
C618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
C977 Quicklime and Hydrated Lime for Soil Stabilization

B. American Association of State Highway and Transportation Officials (AASHTO) latest edition
T88 Mechanical Analysis of Soils

1.04 QUALITY ASSURANCE

Independent testing laboratory selected and paid by owner shall be retained to perform construction testing on filling operations and subgrade analysis as specified in Section 02200 and as stated herein.

1.05 SUBMITTALS

A. Shop drawings or details pertaining to excavating and filling for pavement are not required unless otherwise shown on the drawings or specifications or if contrary procedures to the project documents are proposed.

B. Submit a sample of each type of off-site fill material that is to be used in backfilling in an air-tight, 10 lb. container for the testing laboratory or submit a gradation and certification of the aggregate material that is to be used to the testing laboratory for review.

PART 2 PRODUCTS

2.01 MATERIALS

A. Fill material from on-site as specified in Section 02200 and approved by the owner or owner's representative.

B. Fill material from off-site as specified in Section 02200 and approved by the owner or owner's representative.

C. Aggregate material as specified in Section 02227.

D. Acceptable stabilization fabrics and geogrids:

1. Mirafi 50OX or 60OX
2. Phillips 66 Supac 6WS
3. Dupont Typar 3401 and 3601
4. Trevira S1114 and S1120
5. Tensar SS-1 and SS-2
6. Exxon GTF-200 or 350

PART 3 EXECUTION

3.01 PREPARATION

A. Identify all lines, elevations and grades necessary to construct pavements, curb and gutter, bases, walkways and roadways as shown in the plans and specifications.

B. Carefully protect benchmarks, property corners, monuments or other reference points.

C. Locate and identify all site utilities that have previously been installed and may be in danger of damage by grading operations.

D. Locate and identify all existing utilities that are to remain and protect them from damage.

E. Over excavate and properly prepare areas of subgrade that are not capable of supporting the proposed systems. These areas shall be stabilized by using acceptable filter fabrics and/or aggregate material placed and compacted as specified.

3.02 EXCAVATION

A. Excavate roadway and pavement areas to line and grade as shown in the plans and specifications.

B. Engage all suitable material into the project fill areas as specified in Section 02200.

C. Unsuitable excavated material is to be disposed of in a manner and location that is acceptable to the owner and local governing agencies.

D. Perform excavation using capable, well maintained equipment and methods acceptable to the owner and the project document requirements.

3.03 FILLING AND SUBGRADE PREPARATION

A. Areas exposed by excavation or stripping and on which subgrade preparations for paving are to be performed, including future pavement areas, shall be scarified to minimum depth of 8", and compacted to minimum of 95% of optimum density, in accordance with ASTM D 698 (or 92% of optimum density, in accordance with ASTM D 1557), at a moisture content of not less than 1% below and not more than 3% above the optimum moisture content. These areas shall then be proofrolled to detect any areas of insufficient compaction. Proofrolling shall be accomplished by making a minimum of two (2) complete passes with a fully-loaded tandem-axle dump truck, or approved equivalent, in each of the two perpendicular directions under the supervision and direction of a field geotechnical engineer. Areas of failure shall be excavated and recompacted as stated above.

B. Fill materials used in preparation of subgrade shall be placed in lifts or layers not to exceed 8" loose measure and compacted to a minimum density of 95% of optimum density, in accordance with ASTM D 698, (or 92% of the optimum density, in accordance with ASTM D 1557) at a moisture content of not less than it below and not more than 3% above the optimum moisture content.

C. The following table stipulates maximum allowable values for plasticity index (PI) and liquid limit (LL) of suitable fill materials to be used in the specified areas, unless specifically stated otherwise on the Drawings:

	PI	LL
*Paving Area, below upper two feet	20	50
*Paving Area, upper two feet	15	40

(*References to Depth are to Proposed Subgrade Elevations)

D. Material imported from off-site shall have a CBR (California Bearing Ratio) or LBR (Limerock Bearing Ratio) value equal to or above the pavement design subgrade CBR or LBR value indicated on the Drawings.

3.04 COMPACTION

A. Maintain optimum moisture content of fill materials to attain required compaction density.

B. All materials shall be tested in accordance with Section 02200.

C. An independent testing laboratory selected and paid by the owner, shall be retained to perform testing on-site.

D. Compaction test will be as specified in Section 02200 together with the following for paving areas:

1. In cut areas not less than one compaction test for every 10,000 square feet.

2. In fill areas, same rate of testing for each 8", lift (measured loose).

E. If compaction requirements are not complied with at any time during construction process, remove and recompact deficient areas until proper compaction is obtained at no additional expense to owner.

3.05 MAINTENANCE OF SUBGRADE

A. Finished subgrades shall be verified to ensure proper elevation and conditions for construction above subgrade.

B. Protect subgrade from excessive wheel loading during construction including concrete trucks and dump trucks.

C. Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in a manner that will comply with compaction requirements by use of material equal to or better than best subgrade material on-site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section.

3.06 FINISH GRADING

A. Finish grading shall be in accordance with Section 02200 and as more specifically stated herein.

B. Grading of paving areas shall be checked by string line from grade stakes (blue tops) set at not more than 501 centers. Tolerances of .10 feet, more or less, will be permitted. Contractor to provide engineering and field staking necessary for verification of lines, grades, and elevations.

3.07 ROCK EXCAVATION (See Section 02229 Rock Removal)

END OF SECTION 02223

SECTION 02227

AGGREGATE MATERIALS

PART 1 GENERAL

1.01 SECTION INCLUDES

Aggregate Materials

1.02 RELATED SECTIONS

A. Section 02050 - Demolition

B. Section 02100 - Site Preparation

C. Section 02200 - Earthwork

D. Section 02221 - Excavation, Backfill and Compaction for Structures

E. Section 02222 - Excavation, Backfill and Compaction for Utilities

F. Section 02223 - Excavation, Backfill and Compaction for Pavement

G. Section 02245 - Soil Stabilization

H. Section 02270 - Slope Protection and Erosion Control

I. Construction Drawings

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM) latest edition.

ANSI/ASTM C136 -	Method for Sieve Analysis of Fine and Coarse Aggregates.
ANSI/ASTM D698 -	Test Methods for Moisture-Density Relations of Soils and Soil-aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
ANSI/ASTM D155 -	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer alnd 18 inch (457 mm) Drop.
ASTM D2167 -	Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
ASTM D2487 -	Classification of Soils for Engineering Purposes.
AS7'M D2922 -	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
ASTM D3017 -	Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.
ASTM D4318 -	Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

B. American Association of State Highway and Transportation Officials (AASHTO) latest edition.

AASHTO T180 -	Moisture-Density Relations of Soils Using a 10-lb (4.54 Kg) Rammer and an 18 inch (457 mm) Drop.
AASHTO M147 -	Materials for Aggregate and Soil-Aggregate.

1.04 QUALITY ASSURANCE

Tests and analysis of aggregate material will be performed in accordance with standard ASTM and AASHTO procedures listed herein.

1.05 SUBMITTALS

A. Submit in air tight containers a 10 pound sample of each aggregate or mixture that is to be incorporated into the project to the testing laboratory designated by the owner.

B. Submit the name of each material supplier and specific type and source of each material. Any change in source throughout the job requires approval of the owner and engineer.

C. Submit materials certificate to on-site independent testing laboratory which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein.

PART 2 PRODUCTS

2.01 MATERIALS

A. All construction and materials shall meet or exceed the requirements of this section and any state highway department specification section referred to or noted on the drawings which pertain to paving base course design, materials, preparation, and/or execution. All materials shall be as indicated on Drawings and shall comply with applicable state highway specification regarding source, quality, gradation, liquid limit, plasticity index, and mix proportioning.

PART 3 EXECUTION

3.01 STOCKPILING

Stockpile on-site at locations indicated by the owner in such a manner that there will be no standing water or mixing with other materials.

3.02 BORROW SITES

Upon completion of borrow operations, clean up borrow areas as indicated on the plans in a neat and reasonable manner to the satisfaction of the property owner, the owner and the engineer.

3.03 TRANSPORTATION

Off-site materials shall be transported to the project using well maintained and operating vehicles. Once on the job site, all transporting vehicles shall stay on designated haul roads and shall at no time endanger any of the improvements by rutting, overloading or pumping the haul road.

END OF SECTION 02227

SECTION 02229

ROCK REMOVAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Removal of identified and discovered rock during excavation.

B. Use of explosives to assist rock removal.

C. Incorporating removed rock into fills and embankments.

1.02 RELATED SECTIONS

A. Section 02200 – Earthwork

B. Section 02221 – Excavation, Backfill and Compacting for Structures

C. Section 02222 – Excavation, Backfill and Compacting for Utilities

D. Section 02223 – Excavation, Backfill and Compacting for Pavement

E. Geotechnical report (if available) for boring locations and findings of subsurface materials and conditions.

F. Construction drawings.

1.03 REFERENCE STANDARDS

NFPA 495 – Code for Explosive Materials

1.04 ENVIRONMENTAL REQUIREMENTS

Determine all environmental effects associated with proposed work and safeguard those concerns as regulated by law and all others by reasonable and practiced methods.

1.05 JOB CONDITIONS

Any discrepancy with plans and specifications regarding amount and type of rock to be removed shall immediately be brought to the attention of the Owner and the Engineer. A revised removal plan and schedule shall subsequently be provided and followed by the Contractor.

1.06 QUALIFICATIONS

Contractor shall submit records of documented experience to the Owner and the Engineer prior to removal of rock by blasting.

PART 2 PRODUCTS

2.01 MATERIALS

Explosives, detonator/delay device and blast mat materials shall be the type recommended by the explosive supplier and shall comply with the requirements of this section.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify site conditions and note subsurface conditions affecting work of this section.

B. Identify required lines, levels and elevations that will determine the extent of the proposed removals.

3.02 ROCK EXCAVATION

A. Rock excavation is defined as igneous, metamorphic or sedimentary rock that cannot be removed by rippers or other mechanical methods and; therefore, requires drilling and blasting. Cut rock to form level bearing at bottom of footing and trench excavations. In utility trenches, excavate rock to 6" below invert elevation of pipe. Remove shaled layers to provide sound and unshattered base for footings or foundations. Reuse excavated materials on-site in accordance with section 02200, if applicable.

B. Comply with all laws, rules, and regulations of Federal, State and local authorities and insurer which govern storage, use, manufacture, sale, handling, transportation, licensing, or other disposition of explosives. Take special precautions for proper use of explosives to prevent harm to human life and damage to surface structures, all utility lines, or other subsurface structures. Do not conduct blasting operations until persons in vicinity have had ample notice and have reached positions of safety.

C. Contractor shall save harmless the Owner, Architect, Engineer and Owner's representative from any claim growing out of use of such explosives. Removal of materials of any nature by blasting shall be done in such a manner and such time as to avoid damage affecting the integrity of design and to avoid damage to any new or existing structure included in or adjacent to work. It shall be contractor's responsibility to determine method of operation to ensure desired results and integrity of completed work.

D. Perform rock excavation in a manner that will produce material of such size as to permit it being placed in embankments in accordance with Section 02200. Remove rock to limits as indicated. Remove loose or shattered rock, overhanging ledges and boulders which might dislodge.

E. Use lean concrete or suitable materials to replace rock overblast or over excavation in building area and in expansion area to facilitate placement of utilities and future footings.

END OF SECTION 02229

SECTION 02245

SOIL STABILIZATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Lime Stabilized Subgrade

B. Cement Stabilized Subgrade

C. Fly Ash Stabilized Subgrade

D. Geotextile Fabric Stabilized Subgrade

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Section 02223 - Excavation, Backfill and Compacting for Pavement

C. Section 02227 - Aggregate Materials

D. Construction Drawings

E. Geotechnical Report (if available) for boring locations and findings of subsurface materials and conditions.

1.03 REFERENCE STANDARDS

A. American Society for Testing Materials (ASTM) latest edition.
C 150 - Portland Cement
C 618 - Fly Ash for Soil Stabilization
C 977 - Quicklime and Hydrated Lime for Soil Stabilization
D 1633 - Test method for compressive strength of molded soil cement cylinders

B. American Association of State Highway and Transportation 6fficials (AASHTO) latest edition.
M 216 - Lime for Soil Stabilization

C. National Lime Association (NLA)
Bulletin 326 - Lime Stabilization Construction Manual

1.04 ENVIRONMENTAL REQUIREMENTS

Do not install mixed materials in wind in excess of 10 mph or when temperature is below 40^0 F.

1.05 QUALITY ASSURANCE

Perform work in accordance with state and local standards in conjunction with requirements specified herein.

1.06 SUBMITTALS

A. Submit a sample of each material to be used in a 10 pound air tight container to the testing laboratory.

B. Submit the name of each materials supplier and specific type and source of each material. Any change in source throughout the job requires approval of the owner or engineer.

C. Submit mix design and materials mix ratio that will achieve specified requirements for soil stabilization of state and local agencies.

PART 2 PRODUCTS

2.01 MATERIALS

A. Quicklime or Hydrated Lime

B. Portland Cement

C. Fly Ash

D. Coarse Aggregate

E. Fine Aggregate

F. Subsoil: Existing Reused

G. Geotextile Fabric for Stabilization

1. Mirafi 500X or 600X
2. Phillips 66 Supac 6WS
3. Dupont Typar 3401 and 3601
4. Trevira S1114 and S1120
5. Tensar SS-1 and SS-2
6. Exxon GTF-200 or 350

2.02 EQUIPMENT

Perform operations using suitable, well maintained equipment capable of excavating subsoil, mixing and placing materials, wetting, consolidation and compaction of material.

PART 3 EXECUTION

3.01 PREPARATION

A. Obtain Engineers approval of the mix design before proceeding with the placement.

B. Do not start stabilization without weather and soil conditions being favorable for the successful application of the proposed material.

C. Proof roll subgrade to identify areas in need of stabilization.

3.02 EXCAVATION

A. Excavate subsoil to a depth sufficient to accommodate soil stabilization.

B. Remove lumped subsoil, boulders and rock that interferes with achieving uniform subsoil conditions.

3.03 SOIL TREATMENT AND BACKFILLING

A. Lime Stabilized Subgrade: Where indicated on Drawings, treat prepared subgrade with hydrated lime in accordance with applicable state highway specification. Compact to not less than 95% of optimum density as determined by ASTM D 698 (or 92% of the optimum density, in accordance with ASTM D 1557).

B. Cement Stabilized Subgrade: where indicated on Drawings, treat prepared subgrade with portland cement in accordance with applicable state highway specification. Compact to not less than 95% of optimum density as determined by ASTM D 698 (or 92% of the optimum density, in accordance with ASTM D 1557).

C. Fly Ash Stabilized Subgrade: where indicated on Drawings, treat prepared subgrade with fly ash in accordance with applicable state highway specification. Compact to not less than 95% of optimum density as determined by ASTM D 698 (or 92% of the optimum density, in accordance with ASTM D 1557).

D. Maintain optimum moisture of mix materials to attain required stabilization and compaction.

E. Finish subgrade surface in accordance with Section 02200.

3.04 GEOTEXTILE FABRIC

A. Place fabric in those areas that are shown on the plans or in those areas that need additional stabilization prior to the placement of the base course.

B. Place fabric specified in the plans and specifications in accordance with the manufacturers recommendations.

END OF SECTION 02245

SECTION 02270

SLOPE PROTECTION AND EROSION CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary and permanent erosion control systems.

B. Slope Protection Systems.

1.02 RELATED SECTIONS

A. Section 02100 - Site Preparation

B. Section 02200 - Earthwork

C. Section 02900 - Landscaping

D. Erosion Control Plan

E. Construction Drawings

1.03 ENVIRONMENTAL REQUIREMENTS

A. The contractor shall protect adjacent properties and water resources from erosion and sediment damage throughout the life of the contract.

PART 2 PRODUCTS

2.01 MATERIALS

A. Quick growing grasses such as wheat, rye or oats.

B. Hay or straw bales.

C. Fencing for siltation control as specified on the plans.

D. Curlex blankets by American Excelsior Company or approved equal.

E. Bale stakes for each bale shall be a minimum of 4 feet in length and shall be either 2 #4 rebars, 2 steel pickets or 2-2"x2" hardwood stakes driven l'-6" to 2'-0" into ground.

F. Temporary mulches such as loose hay, straw, netting, wood cellulose or agricultural silage.

G. Fence stakes shall be metal stakes a minimum of 8 feet in length.

H. RipRap (See Section 02200)

PART 3 EXECUTION

3.01 PREPARATION

A. Review site erosion control plan.

B. Deficiencies or changes in the erosion control plan as it is applied to current conditions will be brought to the attention of the Owner and the Engineer for remedial action.

3.02 EROSION CONTROL AND SLOPE PROTECTION IMPLEMENTATION

A. Place erosion control systems in accordance with the erosion control plan.

B. The Owner has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and embankment operations and to direct the contractor to provide immediate permanent or temporary pollution control measures. The contractor will be required to incorporate all permanent erosion control features into the project at the earliest practical time to minimize the need for temporary controls. Cut slopes shall be permanently seeded and mulched as the excavation proceeds to the extent considered desirable and practical.

C. The temporary erosion control systems installed by the contractor shall be maintained as directed by the Owner to control siltation at all times during the life of the -contract. The contractor must respond to any maintenance or additional work ordered by the Owner within a 48 hour period.

D. Any additional material and work required and authorized by the Owner which is beyond the extent of the erosion control plan shall be paid for by the owner.

E. Slopes that erode easily shall be temporary seeded as the work progresses with a wheat, rye or oats application (See Section 02900).

3.03 STORM WATER POLLUTION PREVENTION PLAN (SWP3)

A. Prepare and submit Notice of Intent (NOI) to Texas Commission of Environmental Quality (TCEQ).

B. The general contractor shall prepare a SWP3 in accordance with all requirements of TXR 150000 and submit to the Architect for review and approval prior to commencing anywork.

C. The general contractor shall implement the SWP3 through completion of the work.

END OF SECTION 02270

SECTION 02 41 16 - STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of buildings and site elements.
2. Disconnecting, capping or sealing, and abandoning in-place or removing site utilities.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.
1. Inspect and discuss condition of construction to be demolished.
2. Review structural load limitations of existing structures.
3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review and finalize protection requirements.
5. Review procedures for noise control and dust control.
6. Review procedures for protection of adjacent buildings.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control, and for noise control. Indicate proposed locations and construction of barriers.
1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain including means of egress from those buildings.

C. Schedule of Building Demolition Activities: Indicate the following:
1. Detailed sequence of demolition work, with starting and ending dates for each activity.
2. Temporary interruption of utility services.
3. Shutoff and capping or re-routing of utility services.

D. Predemolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by demolition operations. Submit before the Work begins.

E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

1.9 FIELD CONDITIONS

A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.

B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.
   1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
   2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
      a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. Hazardous materials will be removed by Owner before start of the Work.
   2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

D. On-site storage or sale of removed items or materials is not permitted.

1.10 COORDINATION

A. Arrange demolition schedule so as not to interfere with Owner's on-site operations or operations of adjacent occupied buildings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

2.2 SOIL MATERIALS

A. Satisfactory Soils: Comply with requirements in Division 31.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.

D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Utilities to be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.
   1. Owner will arrange to shut off utilities when requested by Contractor.
   2. Arrange to shut off utilities with utility companies.
   3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
   4. Cut off pipe or conduit a minimum of 24 inches (610 mm) below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
   5. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.4 PROTECTION

A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.

B. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
   1. Strengthen or add new supports when required during progress of demolition.

C. Existing Utilities to Remain: Maintain utility services to remain and protect from damage during demolition operations.
   1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
   2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
      a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.

D. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Section 01 50 00 "Temporary Facilities and Controls."
   1. Protect adjacent buildings and facilities from damage due to demolition activities.
   2. Protect existing site improvements, appurtenances, and landscaping to remain.
   3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
   4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
   5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
   6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
   7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.

E. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.5 DEMOLITION, GENERAL

A. General: Demolish indicated buildings and site elements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
   1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
   2. Maintain fire watch during and for at least 2 hours after flame-cutting operations.
   3. Maintain adequate ventilation when using cutting torches.
   4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
   2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

3.6 DEMOLITION BY MECHANICAL MEANS

A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.

B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
   1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.

C. Existing Utilities: Demolish and remove existing utilities and below-grade utility structures.

D. Hydraulic Elevator Systems: Demolish and remove elevator system, including cylinder, plunger, well assembly, steel well casing and liner, oil supply lines, and tanks.

3.7 SITE RESTORATION

A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.

B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.8 REPAIRS

A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.9 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction and recycle or dispose of them.
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Do not burn demolished materials.

3.10 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.
   1. Clean roadways of debris caused by debris transport.

END OF SECTION 02 41 16

SECTION 02505

PAVING BASE COURSE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Granular Base

B. Caliche Base

C. Full Depth Asphalt sage

D. Hot-Mix Sand Asphalt Base

E. Soil Cement Stabilized Base

1.02 RELATED SECTIONS

A. Section 02100 - Site Preparation

B. Section 02200 - Earthwork

C. Section 02227 - Aggregate Materials

D. Section 02245 - Soil Stabilization

E. Section 02511 - Asphaltic Concrete Paving

F. Section 02520 - Portland Cement Concrete Paving

G. Section 02525 - Curbs and Sidewalks

H. Section 02900 - Landscaping

I. Construction Drawings

1.03 REFERENCES

A. ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304. 8 mm) Drop.

B. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using 10 lb (4.54 Kg) Rammer and I8 inch (457 mm) Drop.

C. ASTM D2167 - Test Method for Density and Unit Weight of Soil in-place by the Rubber Balloon Method.

D. ASTM D1556 - Test Method for Density of Soil in-place by the Sand-Cone Method.

E ASTM D2922 - Test Methods for Density of Soil and Soil- Aggregate in-place by Nuclear Methods (Shallow Depth), Method 8 (Direct Transmission).

F. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. Submit materials certificate to on-site independent testing laboratory which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein.

PART 3 EXECUTION

3.01 EXAMINATION

Contractor shall verify that the subgrade has been inspected, tested and the gradients and elevations are correct, dry and properly prepared.

3.02 CONSTRUCTION

A. Perform base course construction in a manner that will drain surface properly at all times and at the same time prevent runoff from adjacent areas from draining onto base course construction.

B. Compact base material to not less than 98% of optimum density as determined by ASTM D 698 or 95% of optimum density, as determined by ASTM D 1557, unless otherwise indicated on the Drawings.

C. Granular Base: Construct to thickness indicated on Drawings. Apply in lifts or layers not exceeding 8", measured loose.

D. Caliche Base; Construct to thickness indicated on Drawings. Use 'Type E, Grade 4 Caliche per TXDOT Spec. Item 247.

Flexible base Type E will be composed of caliche (argillaceous Limestone, calcareous or calcareous clay particles) and may contain stone, conglomerate, gravel, sand or granular materials when these materials are I situ with the caliche.

Flexible base (TY E GR 4) shall conform to the following requirements:

Retained on Sq. Sieve	Percent Retained
2"	0
½"	20-60
No. 4	40-75
No. 40	70-90
Max. PI:	15
Max. Wet Ball PI:	15
Wet Ball Mill Max Amount:	50
Min. Comp. Strength PSI:	150 at 15 PSI lateral pressure
Triaxial Test	Tex-117-E

The Wet Ball Test (Tex-116-E) shall be run and the Plasticity Index of the material passing the No. 40 sieve shall be determined (Wet Ball PI).

Two (2) percent lime by weight may be incorporated into the Flexible Base in the field at the Owner/Engineer's direction and will be paid for at the amount bid.

The percent of density as determined by Compaction Ratio (Tex-113-E) for the new Flexible Base shall be a minimum of 98%.

For water added under Item 247, the sulfate content will not exceed 3000-ppm and the chloride content will not exceed 3000-ppm.

E. Asphalt Institute Type IV Mix for Full Depth Asphalt Base: Construct to thickness indicated on Drawings in lifts or layers not exceeding 3", measured loose.

F. Asphalt Institute Type VI, VII, or VIII Mixes for Hot-mix Sand Asphalt Bases: Construct to thickness indicated on Drawings. Apply in lifts or layers not exceeding 3", measured loose.

G. Soil Cement Stabilized Base: Construct to thickness and strength as indicated on Drawings and in accordance with applicable state highway specifications. If not indicated on the Drawings, the minimum compressive strength shall be 500 p.s.i., tested at 28 days.

3.03 FIELD QUALITY CONTROL

A. An Independent Testing Laboratory, selected and paid by owner, shall be retained to perform construction testing of in-place base courses for compliance with requirements for thickness, compaction, density and tolerance. Paving base course tolerances shall be verified (by rod and level readings on not more than fifty-foot centers) to be not more than 0.05 feet above design elevation which will allow for paving thicknesses as shown in the Drawings. Contractor shall provide instruments and a suitable benchmark.

B. The following tests shall be performed on each type of material used as base course material:

1. Moisture and Density Relationship: ASTM D 698 or ASTM D 1557.

2. Mechanical Analysis: AASHTO T-88.

3. Plasticity Index: ASTM D-4318.

4. Base material thickness: Perform one test for each 20,000 square feet of in-place base material area.

5. Base material compaction: Perform one test in each lift for each 20,000 square feet of in-place base material area.

6. Test each source of base material for compliance with applicable state highway specifications.

C. Field density tests for in-place materials shall be performed according to one of the following standards as part of construction testing requirements:

1. Sand-Cone Method: AS7M D 1556.

2. Balloon Method: ASTM D 2167.

3. Nuclear Method: ASTM D 2922, Method B (Direct Transmission).

D. Independent Testing Laboratory shall prepare test reports that indicate test location, elevation data, and test results. The Owner, Engineer, and Contractor shall be provided with copies of reports within 96 hours of time test was performed. In event that any test performed fails to meet these Specifications, the Owner, Engineer and Contractor shall be notified immediately by Independent Testing Laboratory. The Owner reserves right to employ Independent Testing Laboratory and to direct any testing that is deemed by them to be necessary. Contractor shall provide free access to site for testing activities.

END OF SECTION 02505

SECTION 02511

ASPHALTIC CONCRETE PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Asphaltic concrete paving; surface course, binder course and base course.

1.02 RELATED SECTIONS

A. Section 02223 - Excavation, Backfill and Compacting for Pavement

B. Section 02500 - Paving and Surfacing

C. Section 02505 - Paving Base Course

D. Section 02520 - Portland Cement Concrete Paving

E. Section 02525 - Curbs

F. Section 02584 - Parking Lot and Roadway Marking

G. Construction Drawings

H. State Highway Department Standard Specifications

1.03 SUBMITTALS

A. Design Mix: Before any asphaltic concrete paving is constructed, submit actual design mix to the Owner's Construction Department for review and/or approval. Design mix submittal shall follow the format as indicated in the Asphalt Institute Manual MS-2, Marshall Stability Method; and shall include the type/name of the mix, gradation analysis, grade of asphalt cement used, Marshall Stability (lbs.), flow, effective asphalt content (percent), and direct references to the applicable highway department specifications sections for each material. The design shall be for a mixture listed in the current edition of the applicable state roadway specifications. Mix designs over three (3) years old will not be accepted by the owner.

B. Material Certificates: Submit materials certificate to on-site independent testing laboratory which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein.

1.04 JOB CONDITIONS

A. Weather Limitations:

1. Apply prime and tack coats when ambient temperature is above 40^0 F, and when temperature has been above 35^o F for 12 hours immediately prior to application. Do not apply when base is wet, contains excess moisture, or during rain.

2. Construct asphaltic concrete paving when atmospheric temperature is above 40^o F.

1.05 REFERENCES

A. MS-2-Mix design methods for asphaltic concrete and other hot mix types per The Asphalt Institute (AI)

B. MS-3-Asphalt Plant Manual per The Asphalt Institute (AI)

C. Hot Mix Asphalt Paving Handbook per US Army Corp of Engineers, UN-13 (CE MP-ET)

D. MS-19-Basic Asphalt Emulsion Manual per The Asphalt Institute (AI)

E. ASTM D946 - Penetration - Graded Asphalt Cement for use in Pavement Construction

F. AASHTO M-226/ASTM D3381 Asphalt Cement

G. AASHTO M-140/ASTM D997 or AASHTO M-208/ASTM D-2397 Tack Coat

H. AASHTO M-117/ASTM D242 Mineral Filler

I. AASHTO T-245/ASTM D1559 Marshall Mix Design

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide asphalt-aggregate mixture as recommended by local or state paving authorities to suit project conditions. Use locally available materials and gradations which meet state highway specifications and exhibit satisfactory records of previous installations.

B. Asphalt Cement: Comply with AASHTO M-226/ASTM D 3381; Table 2 AC-10, AC-20, or AC-30, viscosity grade, depending on local mean annual air temperature. (See chart below):

Temperature Condition	Asphalt Grades
Cold, mean annual air temperature at 7 degrees C (45 degrees F) or lower	AC-10 85/100 pen.
Warm, mean annual air temperature between 7 degrees C (45 degrees F) and 24 degrees C (75 degrees F)	AC-20 60/70 pen.
Hot, mean annual air temperature at 24 degrees C (75 degrees F) or higher	AC-30

C. Prime Coat: A medium curing cut-back asphalt or an asphalt penetrating prime coat consisting of either MC-30 or SS-1h.

D. Tack Coat: Emulsified asphalt; AASHTO M-140/ASTM D 997 or AASHTO M 208/ASTM D 2397, SS-1h, CSS-1, or CSS-1h, diluted with one part water to one part emulsified asphalt.

E. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with AASHTO M-17/ASTM D 242, if recommended by applicable state highway standards.

F. Asphalt-Aggregate Mixture: Unless otherwise noted on the Drawings, the Design Mix shall have a minimum stability based on 50-blow Marshall complying with ASTM D 1559 of 1000 lb with a flow between 8 and 16.
The Design Mix shall be within sieve analysis and bitumen ranges below:

SIEVE ANALYSIS OF MIX

Square Sieve	Total Percent Passing	Percent Tolerance
¾"	100	7%
1/2"	80 – 100%	5%
3/8"	65 - 93%	4%
#8	40 - 55%	4%
#50	12 - 27%	2%
#200	0 - 10%	0%

Percent bitumen by weight of total mix: 5.0 - 8.5.
Air voids: 3-6%.

Percent aggregate voids filled with asphalt cement: 70 – 82%.
Allowable variance of percent bitumen by weight of total mix = 0.4

2.02 EQUIPMENT

Maintain equipment in satisfactory operating condition and correct breakdowns in a manner that will not delay or be detrimental to progress of paving operations.

PART 3 EXECUTION

3.01 PREPARATION

A. Remove loose material from compacted base material surface immediately before applying prime coat.

B. Proof roll prepared base material surface to check for areas requiring additional compaction and areas requiring removal and recompaction.

C. Do not begin paving work until deficient base material areas have been corrected and are ready to receive paving.

3.02 APPLICATIONS

A. Prime Coat:

1. Apply bituminous prime coat to all base material surfaces where asphaltic concrete paving will be constructed.

2. Apply bituminous prime coat in accordance with APWA Section 2204 and applicable state highway specifications.

3. Apply at minimum rate of 0.25 gallon per square yard over compacted base material. Apply to penetrate and seal, but not flood surface.

4. Make necessary precautions to protect adjacent areas from overspray.

5. Cure and dry as long as necessary to attain penetration of compacted base and evaporation of volatile substances.

. Tack Coat:

1. Apply to contact surfaces of previously constructed asphaltic concrete base courses or portland cement concrete and surfaces abutting or projecting into asphaltic concrete or into asphaltic concrete pavement.

2. Apply tack coat to asphaltic concrete base course or sand asphalt base course. Apply emulsified asphalt tack coat between each lift or layer of full depth asphaltic concrete and sand asphalt bases and on surface of all such bases where asphaltic concrete paving will be constructed.

3. Apply emulsified asphalt tack coat in accordance with APWA Section 2204 and applicable state highway specifications.

4. Apply at minimum rate of 0.05 gallon per square yard of surface.

5. Allow to dry until at proper condition to receive paving.

3.03 ASPHALTIC CONCRETE PLACEMENT

A. Place asphaltic concrete mixture on completed compacted subgrade surface, spread, and strike off. Spread mixture at following minimum temperatures:

1. When ambient temperature is between 40^{O} F and 50^{0} F, mixture temp. = 285^{o} F

2. When ambient temperature is between 50^{O} F and 60^{0} F, mixture temp. = 280^{O} F

3. When ambient temperature is higher than 60^{0} F, mixture temp. = 275^{o} F

B. Whenever possible, all pavement shall be spread by a finishing machine; however, inaccessible or irregular areas may be placed by hand methods. The hot mixture shall be spread uniformly to the required depth with hot shovels and rakes. After spreading, the hot mixture shall be carefully smoothed to remove all segregated course aggregate and rake marks. Rakes and lutes used for hand spreading shall be of the type designed for use on asphalt mixtures. Loads shall not be dumped faster that they can be properly spread. workers shall-not stand on the loose mixture while spreading.

C. Paving Machine Placement: Apply successive lifts of asphaltic concrete in transverse directions with the surface course placed in the direction of surface-water flow. Place in typical strips not less than 10'- 0" wide.

D. Joints: Make joints between old and new pavements, or between successive days and work in a manner that will provide a continuous bond between adjoining work. Construction joints shall have same texture, density, and smoothness as other sections of asphaltic concrete course. Clean contact surfaces of all joints and apply tack coat.

3.04 ROLLING AND COMPACTION

A. The mixture, after being spread, shall be thoroughly compacted by rolling as soon as it will bear the weight of the rollers without undue displacement. The number, weight, and types of rollers and sequences of rolling operations shall be such that the required density and surface are consistently attained while the mixture is in a workable condition.

B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling with hot material.

D. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.

E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.

F. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot asphaltic concrete. Compact by rolling to maximum surface density and smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.05 FIELD QUALITY CONTROL

A. Independent Testing Laboratory, selected and paid by Owner, shall be retained to perform construction testing of in-place asphaltic concrete courses for compliance with requirements for thickness, compaction and surface smoothness. Asphaltic surface and base courses shall be randomly cored at a minimum rate of one core for every 20,000 square feet of paving. However, no less than three cores in light duty areas and three cores in heavy duty areas shall be obtained. Coring holes shall be immediately filled with full-depth asphalt or with concrete. Asphaltic Concrete pavement samples shall be tested for conformance with the mix design.

B. Grade Control: Establish and maintain required lines and elevations.

C. Thickness: In-place compacted thickness shall not be less than thickness specified on the drawings. Areas of deficient paving thickness shall receive a tack coat and a minimum ill overlay; or shall be removed and replaced to the proper thickness, at the discretion of the Owner; until specified thickness of the course is met or exceeded at no additional expense to the Owner.

D. Surface Smoothness: Testing shall be performed on the finished surface of each asphalt concrete course for smoothness, using 10'-0" straightedge applied parallel with, and at right angles to centerline of paved area. The results of these tests hall be made available to the owner upon request. Surfaces will not be acceptable if the following 10' straightedge tolerances for smoothness are exceeded.

Base Course Surface:	¼"
Wearing Course Surface:	3/16"

E. Check surface areas at intervals necessary to eliminate ponding areas. Remove and replace unacceptable paving as directed by Owner.

F. Compaction: Field density test for in place materials shall be performed by examination of field cores in accordance with one of the following standards:

1. Bulk specific gravity of paraffin-coated specimens: ASTM D-1188.

2. Bulk specific gravity using saturated surface-dry specimens: ASTM D-2726.

Rate of testing shall be one core per 20,000 square feet of pavement, with a minimum of 3 cores from heavy- duty areas and 3 cores from standard-duty areas. Cores shall be cut from areas representative of the project.

Areas of insufficient compaction shall be delineated, removed, and replaced in compliance with the specifications at no expense to the Owner.

END OF SECTION 02511

SECTION 02525

CURB AND SIDEWALKS

PART I GENERAL

1.01 SECTION INCLUDES

A. Combination concrete curb and gutter

B. Concrete Curb

C. Concrete Flume

D. Concrete Sidewalk

1.02 RELATED SECTIONS

A. Section 02100 - Site Preparation.

B. Section 02227 - Aggregate Material.

C. Section 02505 - Paving Base Course.

D. Section 02584 - Parking Lot and Roadway Marking.

E. Section 03300 - Cast-in-place Concrete (See Architectural/Building Specifications).

F. State Highway Department Standard Specifications.

G. Construction Drawings.

1.03 REFERENCES

A. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

B. ANSI/ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural construction.

C. ANSI/ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

D. AS774 C33 - Concrete Aggregates.

E. ASTM C94 - Ready Mix Concrete.

F. AS7M C150 - Portland Cement

G. AS7M C260 - Air-Entraining Admixtures for Concrete.

H. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.

I. AS7M C494 - Chemical Admixtures for Concrete.

J. FS TT-C-800 - Curing Compound, Concrete, for New and Existing Surfaces.

1.05 PERFORMANCE REQUIREMENTS

A. Contractor shall maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

PART 2 PRODUCTS

2.01 MATERIALS

A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. The forms shall be of a depth equal to the depth of curbing or sidewalk, and so designed as to permit secure fastening together at the tops. Coat forms with non-staining type coating that will not discolor or deface surface of concrete.

B. Concrete Materials: Comply with requirements of applicable Section 03300 for concrete materials, admixtures, bonding materials, curing materials, and others as required.

C. Joint Fillers: Resilient premolded bituminous impregnated fiberboard units complying with ASTM D 1751 FS HH-F-341, Type II, Class A; or AASHTO M 153, Type I.

D. Joint Sealers: Non-priming, pourable, self -leveling polyurethane. Acceptable sealants are Sonneborn "Sonolastic Paving Joint Sealant" Sonneborn "Sonomeric CT 1 Sealant", Sonneborn "Sonomeric CT 2 Sealant", Mameco "Vulken 4511, or Woodmont Products 'Chem-Caulk".

2.02 MIX DESIGN AND TESTING

A. Concrete mix design and testing shall comply with requirements of applicable Section 03300.

B. Design mix to produce normal weight concrete consisting of Portland cement, aggregate, water-reducing admixture, air-entraining admixture, and water to produce the following properties:

1. Compressive Strength: 3,500 psi, minimum at 28 days, unless otherwise indicated on the Drawings.

2. Slump Range: 2"-5" at time of placement.

3. Air Entrainment: 5% to 8%.

PART 3 EXECUTION

3.01 PREPARATION

A. Proof-roll prepared base material surface to check for unstable areas. The paving work shall begin after any unsuitable areas have been corrected and are ready to receive paving. Compaction testing for the base material shall be completed prior to the placement of the paving.

B. Surface Preparation: Remove loose material from compacted base material surface to produce a firm, smooth surface immediately before placing concrete.

3.02 INSTALLATION

A. Form Construction

1. Set forms to required grades and lines, rigidly braced and secured.

2. Install sufficient quantity of forms to allow continuance of work and so that forms remain in place a minimum of 24 hours after concrete placement.

3. Check completed formwork for grade and alignment to following tolerances:

Top of forms not more than 1/8" in 10' – 0".
Vertical face on longitudinal axis, not more than ¼" in 10'-0".

4. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage.

B. Concrete Placement

1. Comply with applicable requirements of Section 03300.

2. Do not place concrete until base material and forms have been checked for line and grade. Moisten base material if required to provide uniform dampened condition at time concrete is placed. Concrete shall not be placed around manholes or other structures until they are at the required finish elevation and alignment.

3. Place concrete using methods which prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Consolidate with care to prevent dislocation of dowels, and joint devices.

4. Deposit and spread concrete in continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hours, place construction joint. Automatic machine may be used for curb and gutter placement at Contractor's option. machine placement must produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified.

C. Joint Construction

1. Contraction Joints: Concrete curb, concrete gutter or concrete curb and gutter, where specified on the plans, shall be constructed in uniform sections of the length specified on the plans. The joints between sections shall be formed either by steel templates 1/8 inch in thickness, of a length equal to the width of the gutter and/or curb,

and with a depth which will penetrate at least 2 inches below the surface of the curb and/or gutter; or with 3/4-inch thick preformed expansion joint filler cut to the exact cross section of the curb and/or gutter; or by sawing to a depth of at least 2 inches while the concrete is between 4 to 24 hours old. If steel templates are used, they shall be left in place until the concrete has set sufficiently to hold its shape, but shall be removed while the forms are still in place.

2. Longitudinal Construction Joints: Concrete curb, concrete gutter or combination concrete curb and gutter, where specified on the plans, shall be tied to concrete pavement with 1/2 inch round deformed reinforcement bars of the length and spacing shown on the plans.

3. Transverse Expansion Joints: Transverse expansion joint in curb, curb and gutter, gutter or sidewalk shall have the filler cut to the exact cross section of the curb, curb and gutter, gutter or sidewalk. The joints shall be similar to the type of expansion joint used in the adjacent pavement.

D. Joint Fillers: Extend joint fillers full-width and depth of joint, and not less than ½" or more than 1" below finished surface where joint sealer is indicated. Furnish joint fillers in one-piece lengths for full width being placed, wherever possible where more than one length is required, lace or clip joint filler sections together.

E. Joint Sealants: All joints shall be sealed with approved exterior pavement joint sealants and shall be installed per manufacturer's recommendations.

3.03 CONCRETE FINISHING

A. After striking off and consolidating concrete, smooth surface by screeding and floating. Adjust floating to compact surface and produce uniform texture. After floating, test surface for trueness with 10'-0" straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide continuous smooth finish.

B. Work edges of sidewalks, gutters, back top edge of integral curb, and formed joints with an edging tool, and round to 1/21, radius. Eliminate tool marks on concrete surface. After completion of floating and troweling when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:

1. Inclined Slab Surfaces: Provide coarse, non-slip finish by scoring surface with stiff-bristled broom perpendicular to line of traffic.

2. Curbs, gutters, and walks: Broom finish by drawing fine-hair broom across surface perpendicular to line of traffic. Repeat operation as necessary to produce a fine line texture.

C. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed.

D. Protect and cure finished concrete paving using acceptable moist-curing methods, more particularly described in the "water-curing" section of ACI 308-81.

3.04 BACKFILL

After the concrete has set sufficiently, the spaces in front and back of the curb and gutter or sidewalk shall be refilled to the required elevation with suitable material which shall be compacted until firm and solid and neatly graded.

3.05 CLEANING AND ADJUSTING

A. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.

B. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials.

END OF SECTION 02525

SECTION 02584

PAVEMENT MARKINGS

PART 1 GENER.AL

1.01 SECTION INCLUDES

A. Painted pavement marking.

B. Painted curbs, guard posts and light pole bases.

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Section 02505 - Paving Base Course

C. Section 02511 - Asphaltic Concrete Paving

D. Section 02520 - Portland Cement Concrete Paving

E. Construction Drawings

1.03 PROJECT CONDITIONS

A. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize flagmen, barricades, warning signs and warning lights as required.

PART 2 PRODUCTS

2.01 MATERIALS

A. The paint shall be a non-bleeding, quick-drying, alkyd petroleum base paint suitable for traffic-bearing surface and shall meet FS 7TP-85E and mixed in accordance with manufacture's instructions before application.

PART 3 EXECUTION

3.01 PREPARATION

A. Sweep and clean surface to eliminate loose material and dust.

B. Where existing pavement markings are indicated on the drawings to be removed or would interfere with the adhesion of new paint, a motorized abrasive device shall be used to remove the markings. The equipment employed shall not damage the existing paving or create a surface hazardous to vehicle or pedestrian traffic. In all areas within public rights-of-way, the method of marking removal shall be approved by governing authority.

3.02 APPLICATION

A. Apply two (2) coats of paint at manufacturer recommended rate without the addition of thinner, with a maximum of 100 square feet per gallon. Apply with mechanical equipment to produce uniform straight edges. At sidewalk curbs and crosswalks, use a straightedge to ensure a uniform, clean, and straight stripe.

B. The following items shall be painted with the colors noted below:

1. Pedestrian Crosswalks: Yellow
2. Exterior Sidewalk Curbs, Light Pole Bases and Guardposts: Yellow
3. Fire Lanes: Red or per local code
4. Lane Striping where separating traffic in opposite directions: Yellow
5. Lane Striping where separating traffic in the same direction: White
6. Handicap Symbols: per local code
7. Parking Stall Striping: plans Yellow, unless otherwise noted

END OF SECTION 02584

SECTION 02605

SEWER STRUCTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Monolithic concrete manhole barrel with the option of monolithic concrete or masonry transition to lid frame, covers, anchorage and accessories.

B. Modular pre-cast concrete manhole barrel with tongue-and-groove joints and with the option of pre-cast concrete or masonry transition to lid frame, covers, anchorage and accessories.

C. Masonry manhole barrel with masonry transition to lid frame, covers, anchorage and accessories.

D. Pre-cast Polyethylene manhole assemblies.

1.02 RELATED SECTIONS

A. Section 02222 - Excavation, Backfill, and Compacting for Utilities

B. Section 02720 - Storm Sewer Systems

C. Section 02730 - Sanitary Sewer Systems

D. Section 03300 - Cast-In-Place Concrete (See Architectural/Building Specifications)

E. Construction Drawings

1.03 REFERENCES

A. ANSI/AS7M C55 - Concrete Building Brick.

B. ASTM A48 - Gray Iron Castings.

C. ASTM C478 – Pre-cast Reinforced Concrete Manhole Sections.

D. ASTM C923 - Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.

E. AS7M D1248 – Pre-cast Polyethylene Manholes.

F. International Masonry Industry All-Weather Council (IMIAC): Recommended Practices and Guide Specification for Cold Weather Masonry Construction.

1.04 SUBMITTALS

A. Shop Drawings: Indicate reference to drawings of manhole locations, elevations, piping with sizes, locations and elevations of penetrations.

B. Product Data: Provide data for manhole covers, manhole steps, component construction, features, configuration, and dimensions.

PART 2 PRODUCTS

2.01 MATERIALS

A. Manhole Barrel: Reinforced pre-cast concrete, in accordance with ASTM C478 with gaskets in accordance with ASTM C923.

1. Construct manholes of pre-cast concrete sections as required by Drawings to size, shape, and depth indicated, but never less than 4'-0" inside diameter.

B. Manhole Barrel: Non-reinforced cast-in-place concrete as specified in Section 03300.

1. Cast-in place Manholes shall be constructed of 3500 psi concrete.

2. Forms shall be made of steel sheets accurately shaped and fabricated of sufficient strength to form dense watertight walls to true dimensions.

3. Concrete shall be deposited in evenly distributed layers of about 18 inches, with each layer vibrated to bond it to the preceding layer.

C. Manhole Barrel: Pre-cast Polyethylene in accordance with ASTM D 1248. Manholes shall be manufactured with factory-molded steps. The nominal cylinder internal diameter shall be 4811 and shall be designed to accept concrete filled polyethylene manhole lids and standard cast iron frames with lid or grate. Manholes shall have compressive strength which meets ASTM D 2412 standards. Acceptable Manufacturers: Advanced Drainage Systems (ADS) or Owner-Approved equivalent manufacturer.

D. Concrete Brick Units: ANSI/ASTM C55, Grade N Type I- Moisture Controlled, normal weight, of same Grade, Type and weight as block units, nominal modular size of 3 5/8 x 7 5/8 x 2 1/4 inches.

E. Mortar and Grout: Mortar for finishing and sealing shall be Class "C". Honeycombing less than two (2) inches deep shall be repaired using Class "D" mortar.

F. Brick Transition Reinforcement: Formed steel 8 gage wire with galvanized finish.

2.02 COMPONENTS

A. Lid and Frame: ASTM A48, Class 30B Heavy Duty Cast iron construction, machined flat bearing surface, removable lid, closed or open as specified on plans; sealing gasket; manufactured by Neenah Foundry Company or approved equal.

B. Manhole Steps: Neenah Foundry Company catalog No. R- 1982-F for pre-cast or catalog No. R-1980-0 for brick/cast-in-place manholes or M.A. Industries PS-1 or approved equal.

C. Base Pad: Cast-in-place concrete as specified in Section 03300.

2.03 CONFIGURATION

A. Barrel Construction: Concentric with eccentric cone top section.

B. Shape: Cylindrical.

C. Clear Inside Dimensions: 48 inch diameter or as indicated on plans.

D. Design Depth: As indicated on plans.

E. Clear Lid Opening: 22 inches minimum.

P. Pipe Entry: Provide openings as indicated on plans.

G. Main and Lateral Pipes: Neatly cut off main and lateral pipes flush with inside of manhole or inlet where they enter structure walls, and point up irregularities and rough edges with non-shrinking grout.

H. Inverts: Shape inverts for smooth flow across structure floor as shown on Drawings. Use concrete and mortar to obtain proper grade and contour and finish surface with fine textured wood float.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify items provided by other sections of Work are properly sized and located.

B. Verify that built-in items are in proper location, and ready for roughing into work.

C. Verify excavation for manholes is correct.

3.02 PREPARATION

Coordinate placement of inlet and outlet pipe or duct sleeves as indicated on plans.

3.03 PLACING PRE-CAST MANHOLE BARREL SECTIONS

A. Place base pad to proper elevation and location and trowel top surface level for placement of manhole barrel.

B. Place manhole barrel plumb and level to correct elevations and anchor to base pad.

1. After completion of slab foundation the first joint of manhole barrel shall be lowered into position, grooved end first and set level and plumb on concrete base. Align and adjust to proper grade prior to placing and forming invert which shall be poured immediately after setting of first section of manhole barrel.

2. Prior to setting subsequent manhole barrel sections, apply primer to tongue and groove ends and allow to set in accordance with manufacturer recommendations. Place "Ram-nek", or equivalent, plastic rope on tongue end. Lower next section into position, and remove excess material from interior of structure. Add additional material on exterior of joint, if necessary, for completely watertight joint.

3.04 MASONRY MANHOLE BARREL CONSTRUCTION

A. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

B. Lay masonry units in running bond. Course 3 brick units and 3 mortar joints to equal 8 inches.

C. Form flush mortar joints.

D. Lay masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

E. Install joint reinforcement 16 inches o.c.

F. Place joint reinforcement in first and second horizontal joints above base pad and below lid frame opening.

G. As work progresses, build-in fabricated metal items.

H. Cut and fit masonry for pipes in accordance with 2.03-6 of this Section.

I. Set cover frames and covers level without tipping, to correct elevations.

END OF SECTION 02605

SECTION 02660

WATER DISTRIBUTION SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

Providing labor, materials, services, equipment, and other necessary items required for the construction of water systems. This shall include, but not be limited to the following: pipe and fittings for site water line including domestic water line and fire sprinkler system water line, valves and fire hydrants, setting line locations, elevations, and grades for water distribution systems work and control system for duration of work including careful maintenance of benchmarks, property corners, monuments, or other reference points.

1.02 RELATED SECTIONS

A. Section 02222 - Excavating, Backfill and Compacting for Utilities.

B. Section 02227 - Aggregate Materials.

C. Section 02605 - Sewer Structures.

D. Section 15300 - Fire Protection. (See Architectural/Building Specifications)

E. Local Governing Authority and Code Requirements.

F. All Necessary Construction Permits.

G. Construction Drawings

1.03 REFERENCES

A. AASHTO T180 - Moisture-Density Relations of Soils Using a l0-lb (4.54 kg) Rammer and an 18-in. (457 mm) Drop.

B. ANSI/ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

C. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

D. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.

E. ANSI/ASTM D2466 - Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.

F. ANSI/AWS A5.8 - Brazing Filler Metal.

G. ANSI/AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

H. ANSI/AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and other liquids.

I . ANSI/AWWA C111- Rubber-Gasket Joints for Ductile Iron and Grey-Iron Pressure Pipe and Fittings.

J. ANSI/AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

K. ANSI/AWWA C500 - Gate Valves, 3 inch through 48 inch NPS, for Water and Sewage Systems.

L. ANSI/AWWA C502 - Dry Barrel Fire Hydrants.

M. ANSI/AWWA C504 - Rubber Seated Butterfly Valves.

N. ANSI/AWWA C508 - Swing-Check Valves for Waterworks Service, 2 inch through 24 inch NPS.

O. ANSI/AWWA C509 - Resilient Seated Gate Valves 3 inch through 12 inch NPS, for Water and Sewage Systems.

P. ANSI/AWWA C600 - Installation of Ductile-Iron Water Mains and Appurtenances.

Q. ANSI/AWWA C606 - Grooved and Shouldered Type Joints.

R. ANSI/AWWA C651 - Disinfecting Water Mains

S. ANSI/AWWA C900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch, for Water.

T. ASTM B88 – Seamless Copper water Tube.

U. ASTM D1785 - Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.

V. ASTM D2241 - Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR).

W. D2855 - Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings.

X. ASTM D2922 - Test Methods for Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth).

Y. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

Z. ASTM D3139 - Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.

AA. ASTM D3035 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter.

BB. AWWA C901 - Polyethylene (PE) Pressure Pipe, Tubing, and Fittings, 1/2 inch through 3 inch, for water.

CC. AWWA C600-82 - Hydrostatic Testing

DD. UL 246 - Hydrants for Fire Protection Service.

1.04 SUBMITTALS

A. Product Data: Provide Engineer with data on pipe materials, pipe fittings, hydrants, valves and accessories.

B. Manufacturer's Certificate: Certify that products meet or exceed state or local requirements.

1.05 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of piping mains, valves, connections, and top of pipe elevations.

B. Identify and describe unexpected variations to subsoil conditions and location of uncharted utilities.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with utility company and/or municipality requirements.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

PART 2 PRODUCTS

2.01 PIPE

A. Pipe sizes less than 3 inch that are installed below grade and outside building shall comply with one or combination of the following:

1. Seamless Copper Tubing: Type "K" soft copper to comply with ASTM B 88-62 and installed with wrought copper (95-5 Tin Antimony solder joint) fittings in accordance with ASTM B16.22.

2. Polyvinyl Chloride (PVC) Water Pipe: Pipe shall conform to ASTM D-2241 with an SDR 21 rating and shall be continually marked with manufacturer's name, pipe size, cell classification, SDR rating, and ASTM D 1784 classification. Pipe joints shall be integrally molded bell ends in accordance with ASTM D 3139 with factory supplied elastomeric gaskets and lubricant.

B. Pipe sizes 3 inch and larger that are installed below grade and outside building shall comply with one of the following:

1. Gray Cast Iron Water Pipe: In accordance with ANSI A21.6, thickness class 22, and pressure class 150. Fittings shall be either mechanical joint or push-on joint and shall comply with ANSI A21.10 or ANSI A21.11.

2. Ductile Iron Water Pipe: In accordance with ANSI A21.51, Fittings shall be either mechanical joint or push-on joint complying with ANSI A21.10 or ANSI 21.11 (AWWA C-151) (CLASS 50).

3. Polyvinyl Chloride (PVC) Water Pipe: Pipe shall meet the requirements of AWWA C-900 and comply with ASTM D 2241, rated SDR 21 (Class 150). Pipe shall be continually marked as for smaller pipes. Pipe joints shall be integrally molded bell ends in accordance with ASTM D 3034, Table 2, with factory supplied elastomeric gaskets and lubricant.

2.04 GATE VALVES - 2 Inches and Larger

A. Manufacturers:
Mueller Resilient Seat Gate Valves or approved equal.

B. ANSI/AWWA C509, Iron body, bronze mounted double disc, parallel seat type, non-rising stem with square nut, single wedge, resilient seat, flanged or mechanical joint ends, control rod, post indicator where indicated on plans, extension box and valve key.

2.05 BALL VALVES - 2 Inches and Smaller

A. Manufacturers:
Mueller Oriseal or approved equal.

B. Brass body, teflon coated brass ball, rubber seats and stem seals, Tee stem pre-drilled for control rod, AWWA compression inlet end, compression outlet with electrical ground connector, with control rod, extension box and valve key.

2.06 BUTTERFLY VALVES - From 2 inches to 24 inches

ANSI/AWWA C504, iron body, bronze disc, resilient replaceable seat, water or lug ends, infinite position lever handle.

2.07 Check valves, post indicator valves and backflow preventors - Refer to Section 15300 (Fire Protection) in the Architectural/Building Specifications

2.08 HYDRANT

A. Hydrant: Type as required by utility company and as shown on plans.

B. Hydrant Extensions: Fabricate in multiples of 6 inches with rod and coupling to increase barrel length.

C. Hose and Steamer Connection: Match sizes with utility company, two hose nozzles, one pumper nozzle.

D. Finish: Primer and two coats of enamel or special coating to as color as required by utility company.

2.09 ACCESSORIES

A. Concrete for Thrust Blocks: Place thrust blocking consisting of 2,500 psi concrete to provide sufficient bearing area to transmit unbalanced thrust from bends, tees, caps, or plugs to undisturbed soil without loading undisturbed soil in excess of 2,500 lbs/sq ft when water main pressure is 100 psi.

MINIMUM THRUST BLOCKING BEARING AREAS

Pipe Diameter	Tees Sq. Ft.	900 Bend Sq. Ft.	45 ° Bend Sq. Ft.	221/2 ° Bend Sq. Ft.	11 ¼ ° Bend Sq. Ft.
3"	1.0	1.0	1.0	1.0	1.0
4"	1.0	1.0	1.0	1.0	1.0
6"	1.5	2.0	1.0	1.0	1.0
8"	2.5	3.5	1.8	1.0	1.0
10"	4.0	5.5	2.8	1.5	1.0
12"	6.0	8.0	4.0	2.0	1.5
14"	8.0	11.0	5.5	3.0	2.0
16"	10.0	14.2	7.0	4.0	3.0
18"	21.0	21.0	12.0	6.0	4.0

B. Locked Mechanical Joint fittings shall be installed where vertical changes in direction are required and, if approved by the Owner and governing authority, can be installed in lieu of the above thrust blocking requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions.

B. Verify that building service connection and municipal utility water main size, location and depth are as indicated.

3.02 PREPARATION

A. Ream pipe and tube ends and remove burro.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare pipe for connections to equipment with flanges or unions.

3.03 BEDDING

A. Excavate pipe trench and place bedding material in accordance with Section 02222 for work of this Section.

3.04 INSTALLATION - PIPE AND FI7TINGS

A. Maintain separation of water main from sanitary and storm sewer piping in accordance with state or local code.

B . Install pipe and fittings in accordance with ANSI/AWWA C600.

C. Install pipe to allow for expansion and contraction without stressing pipe or joints or as specified by pipe manufacturer.

D. Install access fittings in accordance with local codes to permit disinfection of water system performed under this Section.

E. Connections with Existing Pipelines: Where connections are made between new work and existing piping, make connection using suitable fittings for conditions encountered. Make each connection with existing pipe at time and under conditions which least interfere with operation of existing pipeline and in compliance with the local utility company.

F. Form and place concrete for thrust blocks or other specified methods of retainage at each change of direction or end of pipe main.

G. Establish elevations of buried piping in accordance with Section 02222 for work in this Section.

H. Backfill trench in accordance with Section 02222.

3.05 INSTALLATION - VALVES AND HYDRANTS

A. Install gate valves as indicated on Drawings and supported on concrete pads with valve stem vertical and plumb. Install valve boxes in a manner that will not transmit loads, stress, or shock to valve body. Center valve box over operating nut of valve vertical and plumb. Securely fit valve box together leaving cover flush with finished surface.

B. Install fire hydrant assemblies as indicated on Drawings in vertical and plum position with steamer/pumper nozzle pointed perpendicular to traffic where hydrant is adjacent to a street, roadway or parking lot drive or toward the protected building unless otherwise directed by local authorities. Support hydrant assembly on concrete pad and firmly braced on side opposite inlet

pipe against undisturbed soil and concrete blocking. Place minimum of 6 cu. ft. of crushed stone or gravel around hydrant base and barrel after thrust blocking has cured at least 24 hours. Exercise care when backfilling and compacting so proper vertical position will not be altered.

3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

Disinfect distribution system with chlorine before acceptance for domestic operation. Amount of chlorine shall be such as to provide dosage of not less than 50 parts/million. Thoroughly flush lines before introduction of chlorinating materials and after contact period of not less than 24 hours, system shall be flushed with clean water until residual chlorine content is not greater than 1.0 part/million. open and close valves in lines being disinfected several times during contact period. After disinfection, take water sample and bacteriologically test in accordance with AWWA specifications. Do not place distribution system in service until approval is obtained from applicable governing authorities.

3.07 SERVICE CONNECTIONS

Provide water service connection in compliance with utility company requirements including reduced pressure backflow prevented if required and water meter with by-pass valves and sand strainer.

3.08 FIELD QUALITY CONTROL

A. Compaction testing of trench backfill shall be performed in accordance with Section 02222.

B. Water distribution system pipe installed below grade and outside building shall be tested in accordance with following procedures:

1. The Contractor shall perform the testing of pipe materials, joints, and/or other materials incorporated into the construction of water mains and force mains to determine leakage and watertightness. All pressure pipeline shall be tested in accordance with Section 4 of AWWA C600-82. In the event any state or local code requires a more stringent test, the more stringent shall apply.

2. Pressure Test:

   After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing and not less than 1.25 times the working pressure at the highest point along the test section.

3. Leakage Test:

   The leakage test shall be conducted concurrently with the pressure test. Leakage is defined as the quantity of water that must be supplied into the newly laid pipeline, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipeline has been filled with water. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

No pipeline installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD\,P}{133200}$$

L = allowable leakage, (gallons per hour)

S = length of pipe tested, (feet)

D = nominal diameter of pipe, (inches)

P = average test pressure during test, (psig)

4. Visible Leakage:

   All visible leaks shall be repaired regardless of the amount of leakage.

5. Acceptance of Installation:

   If any test of pipe laid in place discloses leakage greater than that specified, the Contractor shall, at his own expense, locate the leak and make repairs as necessary until the leakage is within the specified allowance.

   Contractor shall supply all water for testing at no expense to the Owner.

6. Contractor shall furnish one copy of results of meter test and hydrostatic pressure test to the Owner and utility company upon completion of water distribution backfilling operations.

END SECTION 02660

SECTION 02720

STORM SEWER SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Site storm sewerage drainage piping, fittings and accessories, and bedding.

B. Connection of building storm water drainage system to municipal sewers.

C. Catch basins, paved area drainage, site surface drainage, and stormwater detention facilities.

1.02 RELATED REQUIREMENTS

A. Section 02222 - Excavation, Backfill, and Compacting for Utilities

B. Section 02270 - Slope Protection and Erosion Control

C. Section 02605 - Sewer Structures

D. Section 02730 - Sanitary Sewerage System

E. Section 03300 - Cast-in-Place Concrete: (See Architectural /Building Specifications)

F. Local governing authority and code requirements.

G. All necessary construction permits.

H. Construction Drawings

1.03 REFERENCES

A. AASTHO M294 and M252 - Corrugated Polyethylene pipe smooth interior.

B. AASHTO M36 - Metallic (Zinc or Aluminum) Coated Corrugated Steel Culverts and Underdrains.

C. AASHTO T180 - Moisture-Density Relations of Soils Using a l0-lb (4.54 kg) Rammer and an 18-in. (457 mm) Drop.

D. ANSI/ASTM A74 - Cast Iron Soil Pipe and Fittings.

E. ANSI/ASTM C12 - Practice for Installing Vitrified Clay Pipe Lines.

F. ANSI/ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.

G. ANSI/AS7M C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

H. ANSI/ASTM C425 - Compression Joints for Vitrified Clay Pipe and Fittings.

I. ANSI/ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

J. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

K. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.

L. ANSI/ASTM D3034 - Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.

M. ASTM C700 - Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated.

N. ASTM D2922 - Test Methods for Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth)

O. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

1.04 DEFINITIONS

Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.05 PROJECT RECORD DOCUMIENTS

A. Accurately record actual locations of pipe runs, connections, catch basins, cleanouts, and invert elevations.

B. Identify and describe unexpected variations to subsoil conditions and location of uncharted utilities.

1.06 COORDINATION

Coordinate the Work with termination of storm sewer connection outside building including connection to municipal storm sewer system.

PART 2 PRODUCTS

2.01 SEWER PIPE MATERIALS AND ACCESSORIES

A. Reinforced Concrete Pipe: Comply with requirements of ASTM C 76, Class III unless another class type is indicated on Drawings, installed with flexible plastic (Bitumen) gaskets at all joints. Gaskets shall comply with AASHTO M-198 751, Type B, and shall be installed in strict accordance with pipe manufacturer's recommendations.

B. Corrugated Steel Pipe: Galvanized, aluminized or bituminous coated as specified on the drawings. Only permitted when specifically indicated on Drawings and shall comply with requirements of ASTM A 760; 16 gage unless another gage is indicated on Drawings. Install with matching band connectors. Install sleeve gaskets in accordance with pipe manufacturer's recommendations. Corrugated steel pipe may be round pipe, arch pipe, or slotted drain pipe as indicated on Drawings. Slotted drain pipe shall have 1.75" wide drain guide waterway openings and 6" minimum height drain guide.

C. Spiral Rib Metal Pipe Type 1R: Galvanized, aluminized or bituminous coated as specified on Drawings. Only permitted when specifically indicated on Drawings. Pipe ends shall be recorrugated and installed with semi-corrugated Hugger-type bands and "O" ring gaskets in accordance with pipe manufacturers installation requirements. Spiral Rib metal pipe must comply with ASTM A 760 Type 1R. Acceptable manufacturer: CONTECH, INC. "ULTRA FLO or ULTRA FLO II" and Caldwell Culvert Co. "Smooth Cor" or approved equal.

D. Polyvinyl Chloride (PVC) Pipe: Only permitted when specifically indicated on Drawings. Pipe and fittings shall comply with ASTM D 3034, rated SDR 35. Pipe shall be continually marked with manufacturer's name, pipe size, cell classification, SDR rating, and ASTM D 3034 classification. Pipe joints shall be integrally molded bell ends in accordance with ASTM D 3034, Table 2, with factory supplied elastomeric gaskets and lubricant.

E. Corrugated Polyethylene Pipe (CPP) Smooth Interior: Only permitted when specifically indicated on Drawings and shall conform with AASHTO Designation M294 and M252. Pipe must be installed in accordance with pipe manufacturers installation Guidelines for Culvert Storm Drainage

Applications. Acceptable manufacturers: Advanced Drainage Systems, Inc. "ADS N-1211 & HANCOR, INC. "Hi-Q" or approved equal.

F. Polyvinyl Chloride (PVC) large diameter closed profile gravity sewer pipe, UNL-B-9: Only permitted when specifically indicated on drawings. Pipe and fittings shall comply with ASTM F-794. Pipe must be installed in accordance with pipe manufacturers installation guidelines. Acceptable manufacturer: Carlon "Vylon H.C." or approved equal.

G. Polyvinyl Chloride (PVC) 8" through 30" diameter, smooth interior, open profile gravity sewer pipe. Only permitted when specifically indicated on drawings. Pipe and fittings shall comply with ASTM F-794 and Uni-Bell Uni-B-9. Pipe must be installed in accordance with pipe manufacturers installation guidelines. Acceptable manufacturer: Extrusion Technologies, Inc. "Ultra-Rib" or approved equal.

2.02 INLETS, CATCH BMINS AND JUNCTION BOXES

A. Lid and frame per details shown on plans.

B. Structure construction in accordance with details shown on plans.

PART 3 EXECUTION

3.01 EXAMINATION

Verify that trench cut and excavation is ready to receive work and excavations, dimensions, and elevations are as indicated on civil engineering drawings.

3.02 PREPARATION

A. Hand trim excavations to required elevations. Correct over excavation with fine aggregate.

B. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.

3.03 BEDDING

A. Excavate pipe trench and place bedding material in accordance with Section 02222 for work of this Section.

3.04 INSTALLATION - PIPE

A. Install pipe, fittings, and accessories in accordance with ASTM C12, ASTM D2321 or manufacturer's instructions and state or local requirements.

B. Install pipe on bedding in accordance with Section 02222 for work in this Section.

C. Lay pipe to slope gradients noted on construction drawings.

D. Refer to Section 02222 for trenching requirements. Do not displace or damage pipe when compacting.

E. Refer to Section 02605 for manhole requirements.

3.05 INSTALLATION - CATCH BASINS, INLETS AND JUNCTION BOXES

A. Form bottom of excavation clean and smooth to correct elevation.

B. Form and place cast-in-place concrete base pad, with provision for storm sewer pipe to be placed at proper elevation.

C. Form and place cast-in-place concrete walls, sleeved at proper elevation to receive storm sewer pipe in accordance with details shown on the plans.

D. Form and place cast-in-place top of structure in accordance with details shown on the plans.

END OF SECTION 02720

SECTION 02730

SANITARY SEWER SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

Furnish labor, materials, services, equipment, and other necessary items required for accompanying the construction of the sanitary sewer systems. This shall include, but not be limited to, the following:

Sanitary sewer drainage piping, Fittings and Accessories, Cleanouts, and Bedding.

Set lines, elevations, and grades for sanitary sewer system work and control system for duration of work, including careful maintenance of benchmarks, property corners, monuments, or other reference points.

1.02 RELATED REQUIREMENTS

A. Construction Drawings

B. Specifications Section 02222 Excavation, Backfilling, and Compacting for Utilities

C. Specifications Section 02605 Sewer Structures

D. Local governing authority and code requirements

E. All necessary construction permits

1.03 REFERENCES

A. ANSI/ASTM A74 - Cast Iron Soil Pipe and Fittings.

B. ANSI/ASTM C12 - Practice for Installing Vitrified Clay Pipe Lines.

C. ANSI/ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.

D. ANSI/ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

E. ANSI/ASTM C425 - Compression Joints for Vitrified Clay Pipe and Fittings.

F. ANSI/ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

G. ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.

H. ANSI/ASTM D3034 - Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.

I. ASTM A746 - Ductile Iron Gravity Sewer Pipe.

J. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings,

K. ASTM C700 - Vitrified Clay Pipe, Extra Strength, Standard Strength and perforated.

L. ASTM D1785 - Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80 and 120.

M. ASTM D2922 - Test Methods for Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth).

N. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

1.04 DEFINITIONS

A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.05 SUBMITTALS

A. Product Data: Provide catalog materials indicating pipe, pipe accessories, and fittings.

B. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.

C. Manufacturer's Certificate: Certify that products meet or exceed ASTM designations.

1.06 COORDINATION

A. Coordinate the Work with termination of sanitary sewer connection outside building, connection to municipal sewer utility service, and trenching.

PART 2

PART 2 PRODUCTS

2.01 SEWER PIPE MATERIALS

A. Polyvinyl Chloride Sanitary Sewer

1. Pipe and fittings shall comply with ASTM D 3034, rated SDR 35 unless otherwise specified by the local utility. Pipe shall be continually marked with manufacturer's name, pipe size, cell classification, SDR rating, and ASTM D 3034 classification.

2. Pipe joints shall be integrally molded bell ends per ASTM D 3034, Table 2, with factory supplied elastomeric gaskets and lubricant.

3. Corrugated Polyvinyl Chloride sewer pipe and fittings shall comply with ASTM F 949. Pipe must be marked with manufacturers name, pipe size, cell classification and ASTM F 949 Classification. Pipe must be installed per the manufacturer`s installation requirements. Acceptable manufacturer: CON'RECH, INC. "A-2000" PVC sewer pipe or Owner-approved equivalent.

B. Corrugated Polyethylene (CPP) Sanitary Sewer

1. Pipe shall be smooth interior, available in sizes 4" thru 18" and shall comply with AASHTO designation #M294 and/or #M252.

2. Pipe fittings shall be thermo-molded PVC conforming to ASTM D 3034, rated SDR 35.

3. Gasket material used with the thermo-molded PVC fittings and the CPP pipe joint assembly shall conform to ASTM F-477.

C. Vitrified Clay Sanitary Sewer

1. Sanitary Sewer Pipe and Fittings: Vitrified clay pipe meeting or exceeding requirements of ASTM C 700.

2. Joints: ASTM C 425 specifications for "Compression Joints for Vitrified Clay Pipe and Fittings.

3. Gaskets: ASTM C 425 specification for "Compression Joints for Vitrified Clay Pipe and Fittings". Gaskets shall be manufactured from high grade, properly vulcanized elastomeric compound consisting of either basic natural or synthetic rubber. Gasket manufacturing tolerances shall comply with Rubber Manufacturer's Association tolerances for gaskets.

4. Lubricant: Suitable for lubricating joint components; no deteriorating effects on gasket or pipe material, will not support growth of fungi or bacteria, and shall be of type recommended by gasket manufacturer.

D. Ductile Iron Sanitary Sewer

1. Ductile Iron Pipe: ASTM A746, Extra Heavy type, inside nominal diameter as specified on plans, bell and spigot end.

2. Ductile Iron Pipe Joint Device: ANSI A21.11, rubber gasket joint devices.

E. Cast Iron Sanitary Sewer

1. Cast Iron Soil Pipe: ANSI/AS7M A74, Extra Heavy type, inside nominal diameter of as specified on plans, bell and spigot end.

2. Cast Iron Pipe Joint Device: ASTM C564, rubber gasket joint devices.

F. Concrete Sanitary Sewer

1. Concrete Pipe: ANSI/ASTM C14, Class 1, 2, or 3 bell and spigot pipe with inside nominal diameter as specified on plans.

2. Concrete Pipe Joint Devices: ANSI/ASTM C443, rubber compression gasket joint devices.

G. Reinforced Concrete Sanitary Sewer

1. Reinforced Concrete Pipe: ANSI/ASTM C76, Class I, II, III, IV, or V as specified on plans, with Wall type A, B, or C; mesh reinforcement; inside nominal diameter as specified, bell and spigot end.

2. Reinforced Concrete Pipe Joint Device: ANSI/ASTM C443, rubber compression gasket joint devices.

2.02 PIPE ACCESSORIES

A. Pipe Joints: Mechanical clamp ring type, stainless steel expanding and contracting sleeve, neoprene ribbed gasket for positive seal.

B. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

2.03 CLEANOUTS

A. Lid and Frame: Heavy Duty cast iron construction, manufactured by Mueller Lid Design: Closed Lid.

B. Shaft Construction: Cast Iron shaft of internal diameter as specified on plans with 2500 psi concrete collar for cleanouts.

PART 3 EXECUTION

3.01 EXAMINATION

Verify that trench cut and excavation is ready to receive work and excavations, dimensions, and elevations are as indicated on civil engineering drawings.

3.02 PREPARATION

A. Hand trim excavations to required elevations. Correct over excavation with fine aggregate.

B. Remove large stones or other hard matter which could damage pipe or impede consistent backfilling or compaction.

3.03 BEDDING

A. Excavate pipe trench and place bedding material in accordance with Section 02222 for work of this Section.

3.04 INSTALLATION - PIPE

A. Install pipe, fittings, and accessories in accordance with ASTM C12, ASTM C14 and/or manufacturer's instructions and state or local requirements.

B. Lay pipe to slope gradients noted on civil engineering drawings.

C. Install pipe on bedding in accordance with Section 02222 for work in this Section.

D. Refer to Section 02222 for trenching requirements. Do not displace or damage pipe when compacting.

E. Refer to Section 02605 for manhole requirements.

F. Connect to building sanitary sewer outlet and municipal sewer system as indicated on the drawings.

3.05 INSTALLATION - CLEANOUTS

A. Form bottom of excavation clean and smooth to correct elevation.

B. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe to be installed to proper elevations.

3.06 FIELD QUALITY CONTROL

A. Compaction testing will be performed in accordance with ANSI/ASTM D698, ASTM D2922 or ASTM D3017.

B. Test sanitary sewer pipe system installed below grade and outside building in accordance with the following procedures:

1. The Contractor shall perform the testing of manhole construction, pipe materials, joints and/or other materials incorporated into the construction of the sanitary sewer system to determine leakage and watertightness. In the event any state or local code requires a more stringent test, the more stringent shall apply.

2. Manhole Testing:

The Owner and/or Governing Agency shall determine the method of manhole testing set forth below. The test method selected will be determined by the depth of each manhole, groundwater level, concrete honeycombing, or other conditions which make the selected test suitable for determining the physical condition and watertightness of the manhole.

2.1 Manhole Exfiltration Testing:

All incoming and outgoing sewer lines shall be plugged the manhole filled with water up to the top of the poured concrete or above the highest precast barrel joint. If the water loss exceeds the maximum allowable as shown below; the manhole shall have failed the test.

Depth of Manhole	Maximum Allowable Water Loss
0-8 feet	1 inch over 5 minutes
greater than 8 feet	1/8 gallon per vertical foot over 5 minutes

2.2 Manhole Vacuum Testing:

The manhole vacuum test shall be performed with suitable apparatus made for such purpose and shall draw a vacuum of 10 inches of Mercury (Hg). The test shall pass if the vacuum remains at 10" of Mercury (Hg) or drops to not less than 9" of Mercury (Hg) in one minute.

3. Flexible Pipe Deflection Testing:

3.1 Allowable Deflection:

The maximum allowable pipe deflection shall not exceed **(5)** five percent of the nominal inside diameter.

3.2 Mandrel:

The mandrel (go/no-go) device shall be cylindrical in shape and constructed with either 9 or 16 evenly spaced arms or prongs. Mandrels with less arms will be rejected as not sufficiently accurate. The contact length of the mandrel's arms shall equal or exceed the nominal inside diameter of the sewer to be inspected. Critical mandrel dimensions shall carry a tolerance of plus or minus 0.01 inch. The mandrell and all necessary equipment for the mandrell test shall be provided by the Contractor.

3.3 Procedure:

The mandrel shall be hand-pulled by the contractor through all flexible pipe sewer lines no earlier than 30 days after the trench has been completely backfilled. Any sections of the sewer not passing the mandrel shall be uncovered and the Contractor shall rebed, reround, or replace the sewer to the satisfaction of the Owner and/or Governing Agency. Any repaired section shall be retested.

3.4 Mandrell O.D. (outside diameter):

The outside diameter of the mandrell shall be set according to the following table:

NOMINAL DIAMETER (IN.)	MANDRELL O.D. (IN.)
6"	5.40
8"	7.12
10"	8.87
12"	10.55
15"	12.89
18"	15.30

3.5 Contractor's Warranty:

The Owner and/or Governing Agency reserves the right to mandrell test any flexible pipe sewer line before acceptance, and also prior to expiration of the first year of operation. If a previously accepted line fails a mandrell test performed during the first year of operation, the defects must be corrected at the Contractor's expense.

4. Air Testing of Gravity Sewers:

4.1 Procedure:

4.1.1 Plug all pipe outlets with suitable test plugs. Brace each plug securely.

4.1.2 Pipe air supply to the pipeline to be tested in such a manner that the air supply may be shut off, pressure observed, and air pressure released from the pipe without workmen entering the manhole.

4.1.3 Add air slowly to the portion of pipe under test until the internal pressure of the line is raised to approximately 4 psig, but less than 5 psig.

4.1.4 Shut the air supply off and allow at lease two minutes for the air pressure to stabilize

4.1.5 When the pressure has stabilized and is at or above the starting test pressure of 3.5 psi, start the test.

4.1.6 Determine the time in seconds with a stopwatch for the pressure to fall 0.5 psig so that the pressure at the end of the time is at or above 3.0 psig.

4.1.7 Compare the observed time with the minimum allowable times in the chart below for pass/fail determination.

1 Pipe Diameter (in.)	2 Minimum Time (min: sec.)	3 Length for Minimum Time (ft.)	4 T ime for Longer Length (sec.).	SPECIFICATION TIME FOR LENGTH (L) SHOWN (MIN:SEC)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	1:53	597	.190L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	.427L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	.760L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.837L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	46:54
30	14:10	50	10.683L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23

4.2 Safety Precautions:

The low pressure air test may be dangerous to personnel if, through lack of understanding or carelessness, a line is over pressurized or plugs are installed improperly. It is

extremely important that the various plugs be installed so as to prevent the sudden expulsion of a poorly inflated plug. As an example of the hazard, a force of 250 pounds; exerted on an 8 inch plug by an internal pressure of 5 psi. Observe the following safety precautions:

4.2.1 No person shall be allowed in the manholes during the test or when a plugged pipe is under pressure.

4.2.2 Gauges, air piping manifolds, and valves, shall be located at the top of the ground.

4.2.3 Install and brace all plugs securely.

4.2.4 Do not over pressurize the lines.

4.3 Ground Water Elevation:

If the pipeline to be tested is below the ground water level, the starting test pressure shall be increased by 0.433 psi for each foot the groundwater level is above the invert of the sewer pipe. In no case shall the starting test pressure exceed 9.0 psig.

4.4 Acceptance of Installation:

No gravity sewer or manhole will be accepted that does not comply with the minimum requirements of tests described in this specification.

4.5 Test Equipment:

All necessary equipment to perform the air test in accordance with this specification shall be provided by the contractor. The test gauge shall preferably have incremental division of 0.10 psi and have an accuracy of at least plus or minus 0.04 psi. In no case shall a test gauge be used which has incremental divisions of greater than 0.25 psi. The gauge shall be of sufficient size in order to determine this accuracy.

4.6 Contractor shall furnish one copy of gravity sewer and manhole test results to the Owner and Governing Agency upon completion of gravity sewer system backfilling operations.

END OF SECTION 02730

SECTION 02 82 00 - ASBESTOS REMEDIATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Asbestos material abatement and disposal.
   2. Accessories necessary for complete removal.

1.3 SUBMITTAL

A. Submit copy of the signed waste manifests indicating the place, time and exact quantity of asbestos, received by an approved landfill.

1.4 QUALITY ASSURANCE

A. Qualifications: Entity having minimum 5 years documented experience, holding required current licenses for the removal, transport, and disposal and related activities relative to the work, having the required personal protective equipment and respirators for abatement operations, with current liability insurance, and who employs workers fully trained and knowledgeable in the removal of hazardous materials.

1.5 STOP ASBESTOS REMOVAL

A. If a verbal or written Stop Asbestos Removal Order is given**,** immediately stop asbestos removal and maintain HEPA filtered negative pressure air flow in the containment and adequately wet any exposed ACM.
   1. Do not resume asbestos removal activity until authorized to do so in writing.
   2. A stop asbestos removal order may be issued at any time it is determined that abatement conditions/activities are not within regulatory requirements or that an imminent hazard exists to human health or the environment.
   3. Work stoppage will continue until conditions have been corrected.

PART 2 - MATERIALS

Not used.

PART 3 - EXECUTION

3.1 REMEDIATION

A. The Owner has conducted an asbestos survey and has determined that asbestos may be present in areas where work will be performed. The survey is made available for review.
   1. As part of the work, the Owner requires asbestos removal to be performed under the construction contract.
   2. Asbestos may be present in vinyl tile under architectural woodwork or covered by, but not encapsulated, carpet materials and other types of flooring.
   3. Asbestos may be present in the ductwork above the ceiling panels.
   4. If asbestos is found, stop work in the area and engage an asbestos removal firm to remediate the asbestos from the area. Do not resume work in the affected areas until the

abatement is complete and authorization to proceed with work in the affected areas is given. Work in areas not affected by asbestos may continue.

B. Assume responsibility and liability for compliance with applicable Federal, State, and Local regulations related to the asbestos abatement work.
   1. Provide and maintain training, accreditations, medical exams, medical records, personal protective equipment (PPE) including respiratory protection including respirator fit testing, as required by applicable Federal, State and Local regulations.
   2. Post required notices prior to the commencement of the work.
   3. Restrict access to containment areas to authorized, trained, and protected personnel.
   4. Prepare and post an emergency plan in clean room and equipment room of the decontamination unit.
   5. Do not permit workers to eat, drink, smoke, chew gum or tobacco, or break the protection of the respiratory protection system in the work area.

C. Entering and Existing Procedures: Establish procedures for entering and existing containment area. Provide personnel decontainment unknit with disposable coveralls, head covers, and clean respirators. Provide shower room between personnel decontainment area and equipment room.

D. Decontamination Procedures: Establish procedures for decontamination upon leaving containment are in accordance with federal and state regulations.

E. Provide negative pressure filtration systems to complete exchange air 4 time per hour. Provide standby system in the event of a machine failure or emergency.
   1. Continuously monitor and record the pressure differential between the work area and the building outside of the work area.

F. Prepare the Affected Area: Remove furnishings and materials to the extent necessary to remediate the asbestos.

G. Containment of Areas: Provide a secure containment work area in accordance with federal and state regulations. Avoid damage to existing partitions and ceilings scheduled to remain to the extent possible.
   1. Establish critical barriers over each opening into the work area.
   2. Close out vents and air ducts to prevent particulates from entering the HVAC system.

H. Debris: Place contaminated debris in a designated location within the containment area.
   1. Place debris in minimum 6 mil poly bags before removing from contaminated areas. Pass Clean or decontaminate bags and pass and pass through a double 6 mil flap doorway into another bag or fiber drum. Remove to disposal dumpster/gondola/vehicle. Do not permit unprotected personnel to come in contact with contaminated bags.
   2. Remove and dispose of contaminated debris legally.

I. Testing: Perform required tests and inspections upon completion of the work. Collect air samples and analyze in accordance with regulations. Upon satisfactory conclusion of testing, remove critical barriers.

J. After thorough decontamination, complete asbestos abatement work upon meeting the regulated area clearance criteria and fulfilling the following:
   1. Remove equipment, materials, and debris from the project area.
   2. Package and dispose asbestos waste as required.
   3. Repair or replace all interior finishes damaged during the abatement work.
   4. Fulfill other project closeout requirements as specified elsewhere in this specification.

3.2 CERTIFICATE OF COMPLETION BY CONTRACTOR

A. Submit a signed *Certificate of Completion* at the completion of the abatement and decontamination of the regulated area.

END OF SECTION 02 82 00

SECTION 03 10 00

CONCRETE FORMS AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Formwork for cast-in place concrete.
2. Shoring, bracing, and anchorage.
3. Architectural form liners.
4. Form accessories.
5. Form stripping.

B. Related Sections:
1. Section 032000 - Concrete Reinforcement.
2. Section 033000 - Cast-in-Place Concrete.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 - Specifications for Structural Concrete.
3. ACI 318 - Building Code Requirements for Structural Concrete.
4. ACI 347 - Guide to Formwork for Concrete.

B. American Forest and Paper Association:
1. AF&PA - National Design Specifications for Wood Construction.

C. The Engineered Wood Association:
1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.

D. ASTM International:
1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
2. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

E. West Coast Lumber Inspection Bureau:
1. WCLIB - Standard Grading Rules for West Coast Lumber.

1.3 DESIGN REQUIREMENTS

A. Design, engineer and construct formwork, shoring and bracing in accordance with ACI 318 to conform to design and applicable code requirements to achieve concrete shape, line and dimension as indicated on Drawings.

1.4 PERFORMANCE REQUIREMENTS

A. Vapor Retarder Permeance: Maximum .03 perms when tested in accordance with ASTM E96, Procedure A.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 347 ACI 301 ACI 318.

B. For wood products furnished for work of this Section, comply with AF&PA.

C. Perform Work in accordance with State Municipality of Highways Public Work's standard.

1.6 COORDINATION

A. Section 013000 - Administrative Requirements: Coordination and project conditions.

B. Coordinate this Section with other sections of work, requiring attachment of components to formwork.

PART 2 PRODUCTS

2.1 WOOD FORM MATERIALS

A. Form Materials: At discretion of Contractor.

2.2 FORMWORK ACCESSORIES

A. Vapor Retarder: Where indicated on Drawings, 10 mil thick polyethylene sheet manufacture by:
1. Stego Wrap Class A: by Stego Industries LLC (887) 464-7834
2. Griffolyn by Reef Industries (800) 231-6074
3. VaporBlock 10 by Raven Industries (800) 635-3456
4. Perminator Vapor – May by W.R. Meadows (800) 342-5976
5. Xtreme by Tex-Trude (281) 452-5961
6. Or Equivalent

B. Bituminous Joint Filler: ASTM D1751.

C. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength and character to maintain formwork in place while placing concrete.

D. Water Stops: Rubber Polyvinyl chloride, minimum 1,750 psi tensile strength, minimum 50 degrees F to plus 175 degrees F working temperature range, inch wide, maximum possible lengths, ribbed profile, preformed corner sections, heat welded jointing.

****** OR ******

E. Waterstop: Flexible strip of bentonite waterproofing compound in coil form for joints in concrete construction.
   1. Colloid Environmental Technologies Company Model.
   2. TC MiraDRi Model.
   3. Paramount Technical Products Model.
   4. Substitutions: Section 016000 - Product Requirements Not Permitted.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 013000 - Administrative Requirements: Coordination and project conditions.

B. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.

C. When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Architect/Engineer.

3.2 INSTALLATION

A. Earth Forms:
   1. Earth forms are not permitted.

B. Formwork - General:
   1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
   2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
   3. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.
   4. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
   5. Complete wedging and bracing before placing concrete.

C. Forms for Smooth Finish Concrete:
   1. Use steel, plywood or lined board forms.
   2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
   3. Install form lining with close-fitting square joints between separate sheets without springing into place.
   4. Use full size sheets of form lines and plywood wherever possible.
   5. Tape joints to prevent protrusions in concrete.
   6. Use care in forming and stripping wood forms to protect corners and edges.
   7. Level and continue horizontal joints.
   8. Keep wood forms wet until stripped.

D. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301 ACI 318.

E. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

F. Obtain Architect/Engineer’s approval before framing openings in structural members not indicated on Drawings.

G. Install fillet and chamfer strips on external corners of beams joists columns and.

H. Install void forms in accordance with manufacturer's recommendations.
1. SureVoid Products, Inc., Englewood, CO (800) 458-5444.

I. Do not reuse wood formwork more than times for concrete surfaces to be exposed to view. Do not patch formwork.

3.3 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer’s specifications. Do not coat forms for concrete indicated to receive “scored finish”. Apply form coatings before placing reinforcing steel.

3.4 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Install formed openings for items to be embedded in or passing through concrete work.

B. Locate and set in place items required to be cast directly into concrete.

C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

D. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.

E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

G. Form Ties:
1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
2. Place ties at least 1 inch away from finished surface of concrete.
3. Leave inner rods in concrete when forms are stripped.
4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.

H. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

I. Construction Joints:
1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
4. Arrange joints in continuous line straight, true and sharp.

J. Openings for Items Passing Through Concrete:
1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
2. Coordinate work to avoid cutting and patching of concrete after placement.
3. Perform cutting and repairing of concrete required as result of failure to provide required openings.

K. Screeds:
1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
2. Slope slabs to drain where required or as shown on Drawings.
3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

L. Screed Supports:
1. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad or base type screed supports which will not puncture membrane.
2. Staking through membrane is not be permitted.

M. Cleanouts and Access Panels:
1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

3.5 FORM CLEANING

A. Clean forms as erection proceeds, to remove foreign matter within forms.

B. Clean formed cavities of debris prior to placing concrete.

C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

3.6 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and removal has been approved by Architect/Engineer.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

D. Leave forms in place for minimum number of days as specified in ACI 347.

3.7 ERECTION TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 301 ACI 318.

****** OR ******

B. Camber slabs and beams 1/4 inch per 10 feet in accordance with ACI 301 ACI 318.

3.8 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements 017000 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

C. Notify Architect/Engineer after placement of reinforcing steel in forms, but prior to placing concrete.

D. Schedule concrete placement to permit formwork inspection before placing concrete.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Reinforcing bars.
2. Welded wire fabric.
3. Reinforcement accessories.

B. Related Sections:
1. Section 031000 - Concrete Forms and Accessories.
2. Section 033000 - Cast-in-Place Concrete.
3. Section 033500 - Concrete: Reinforcement for concrete floor toppings.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 301 - Specifications for Structural Concrete.
2. ACI 318 - Building Code Requirements for Structural Concrete.
3. ACI 530.1 - Specifications for Masonry Structures.
4. ACI SP-66 - ACI Detailing Manual.

B. ASTM International:
1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
2. ASTM A184/A184M - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
3. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
4. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
5. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
6. ASTM A704/A704M - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
7. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
8. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
9. ASTM A775/A775M - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
10. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.
11. ASTM A934/A934M - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.

12. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
13. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Reinforcing Steel Bars.

C. American Welding Society:
1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

D. Concrete Reinforcing Steel Institute:
1. CRSI - Manual of Standard Practice.
2. CRSI - Placing Reinforcing Bars.

1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and welded wire fabric, bending and cutting schedules, and supporting and spacing devices.

C. Certificates: Submit AWS qualification certificate for welders employed on the Work.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
1. Submit certified copies of mill test report of reinforcement materials analysis.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with CRSI - Manual of Standard Practice, ACI 301, and ACI 318.

B. Prepare shop drawings in accordance with ACI SP-66.

1.5 QUALIFICATIONS

A. Welders: AWS qualified within previous 12 months.

1.6 COORDINATION

A. Section 013000 - Administrative Requirements: Coordination and project conditions.

B. Coordinate with placement of formwork, formed openings and other Work.

PART 2 PRODUCTS

2.1 REINFORCEMENT

A. Deformed and Plain Reinforcement: ASTM A615/A615M; 60 ksi yield strength, steel bars, unfinished.

2.2 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gage annealed.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor retarder puncture.

C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic tipped steel; size and shape to meet Project conditions.

D. Reinforcing Splicing Devices: Mechanical type; full tension and compression; sized to fit joined reinforcing.

E. Epoxy Coating Patching Material: Type as recommended by coating manufacturer.

2.3 FABRICATION

A. Fabricate concrete reinforcement in accordance with CRSI Manual of Practice, and ACI 318, on and all applicable codes.

B. Form standard hooks for 180 degree bends, 90 degree bend, stirrup and tie hooks, and seismic hooks as indicated on Drawings.

C. Form reinforcement bends with minimum diameters in accordance with ACI 318 and all applicable codes.

D. Fabricate column reinforcement with offset bends at reinforcement splices.

E. Form spiral column reinforcement from minimum 3/8 inch diameter continuous deformed bar or wire.

F. Form ties and stirrups from the following:
1. For bars No. 10 and Smaller: No. 3 deformed bars.
2. For bars No. 11 and Larger: No. 4 deformed bars.

G. Weld reinforcement in accordance with AWS D1.4.

H. Galvanized Epoxy-Coated Reinforcement: Clean surfaces, weld and re-protect welded joint in accordance with CRSI.

I. Locate reinforcement splices not indicated on Drawings, at point of minimum stress. Review location of splices with Architect/Engineer.

2.4 SOURCE QUALITY CONTROL

A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.

B. Make completed reinforcement available for inspection at manufacturer's factory prior to packaging for shipment. Notify Architect/Engineer at least seven days before inspection is allowed.

C. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
   1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 EXECUTION

3.1 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position beyond specified tolerance.
   1. Do not weld crossing reinforcement bars for assembly.

B. Do not displace or damage vapor retarder.

C. Accommodate placement of formed openings.

D. Space reinforcement bars with minimum clear spacing in accordance with ACI 318 of one bar diameter, but not less than 1 inch.
   1. Where bars are indicated in multiple layers, place upper bars directly above lower bars.

E. Maintain concrete cover around reinforcement in accordance with ACI 318 applicable code as follows:

Footings and Concrete Formed Against Earth		3 inches
Concrete exposed to earth or weather	No. 6 bars and larger	2 inches
	No. 5 bars and smaller	1-1/2 inches
Supported Slabs, Walls, and Joists	No. 14 bars and larger	1-1/2 inches
	No. 11 bars and smaller	3/4 inches
Beams and Columns		1-1/2 inches
Shell and Folded Plate Members	No. 6 bars and larger	3/4 inches
	No. 5 bars and smaller	1/2 inches

3.2 ERECTION TOLERANCES

A. Section 014000 - Quality Requirements: Tolerances.

B. Install reinforcement within the following tolerances for flexural members, walls, and compression members:

Reinforcement Depth	Depth Tolerance	Concrete Cover Tolerance
Greater than 8 inches	plus or minus 3/8 inch	minus 3/8 inch
Less than 8 inches	plus or minus 1/2 inch	minus 1/2 inch

C. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.

3.3 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Field inspection and testing will be performed by Owner's testing laboratory in accordance with ACI 318 and IBC 2006.

C. Provide free access to Work and cooperate with appointed firm.

D. Reinforcement Inspection:
1. Placement Acceptance: Specified and ACI 318 material requirements and specified placement tolerances.
2. Welding: Inspect welds in accordance with AWS D1.1.
3. Periodic Placement Inspection: Inspect for correct materials, fabrication, sizes, locations, spacing, concrete cover, and splicing.
4. Weldability Inspection: Inspect for reinforcement weldability when formed from steel other than ASTM A706/A706M.
5. Continuous Weld Inspection: Inspect reinforcement as required by ACI 318.
6. Periodic Weld Inspection: Other welded connections.

3.4 SCHEDULES

A. Reinforcement For Superstructure Framing Members: Deformed bars, unfinished.

B. Reinforcement For Foundation Wall Framing Members and Slab-on-Grade:Deformed bars and wire fabric, galvanized finish.

C. Reinforcement For Parking Structure Framing Members: Deformed bars, epoxy-coated finish.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete for the following:
1. Foundation walls.
2. Supported slabs.
3. Slabs on grade.
4. Control, expansion and contraction joint devices.
5. Equipment pads.
6. Light pole base.
7. Flagpole base.

B. Related Sections:
1. Section 031000 - Concrete Forms and Accessories: Formwork and accessories. Placement of joint device joint device anchors in formwork.
2. Section 032000 - Concrete Reinforcement.
3. Section 033500 - Concrete Finishing.
4. Section 033900 - Concrete Curing.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 301 - Specifications for Structural Concrete.
2. ACI 305 - Hot Weather Concreting.
3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
4. ACI 308.1 - Standard Specification for Curing Concrete.
5. ACI 318 - Building Code Requirements for Structural Concrete.

B. ASTM International:
1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
2. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
3. ASTM C33 - Standard Specification for Concrete Aggregates.
4. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
5. ASTM C42/C42M - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
6. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
7. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
8. ASTM C150 - Standard Specification for Portland Cement.
9. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
10. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

11. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
12. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
13. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
14. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
15. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
16. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
17. ASTM C685/C685M - Standard Specification for Concrete Made By Volumetric Batching and Continuous Mixing.
18. ASTM C845 - Standard Specification for Expansive Hydraulic Cement.
19. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
20. ASTM C1017/C1017M - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
21. ASTM C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
22. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
23. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
24. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
25. ASTM C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
26. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
27. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
28. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
29. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
30. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
31. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
32. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
33. ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
34. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.3 PERFORMANCE REQUIREMENTS

A. Vapor Retarder Permeance: Maximum .03 perm when tested in accordance with ASTM E96.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on joint devices, attachment accessories, admixtures.

C. Design Data:
1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for the following:
a. Hot and cold weather concrete work.
b. Air entrained concrete work.
2. Identify mix ingredients and proportions, including admixtures.

3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.

D. Manufacturer's Installation Instructions: Submit installation procedures and interface required with adjacent Work.

1.5 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution Requirements: Closeout procedures.

B. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301 and ACI 318.

B. Conform to ACI 305 when concreting during hot weather.

C. Conform to ACI 306.1 when concreting during cold weather.

D. Acquire cement and aggregate from one source for Work.

1.7 COORDINATION

A. Section 013000 - Administrative Requirements: Coordination and project conditions.

B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Section 016000 - Product Requirements: Environmental conditions affecting products on site.

B. Maintain concrete temperature after installation at minimum 50 degrees F for minimum 7 days.

1.9 COORDINATION

A. Section 013000 - Administrative Requirements: Coordination and project conditions.

B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I - Normal

B. Normal Weight Aggregates: ASTM C33.
1. Coarse Aggregate Maximum Size: 1.5

C. Water: ACI 318; potable, without deleterious amounts of chloride ions.

2.2 ADMIXTURES

A. Air Entrainment: ASTM C260.

B. Fly Ash: ASTM C618 type C or F.

C. Silica Fume: ASTM C1240.

2.3 ACCESSORIES

A. Vapor Retarder: ASTM E1745 Class A; 10 mil thick; type recommended for below grade application. Furnish joint tape recommended by manufacturer.

B. Non-Shrink Grout: ASTM C1107, premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

2.4 JOINT DEVICES AND FILLER MATERIALS

A. Joint Filler; Asphalt impregnated fiberboard or felt, tongue and groove profile.

****** OR ******

B. Joint Filler: ASTM D1752; Closed cell, resiliency of 95 percent if not compressed more than 50 percent of original thickness.

C. Sealant: ASTM C309, Type I approved by Asphalt and Vinyl composition Tile Institute, 30% minimum solids content.

2.5 CONCRETE MIX

A. Select proportions for normal weight concrete in accordance with ACI 301 Method 1

B. Provide concrete for the following criteria:

Material and Property	Measurement
Compressive Strength (7 day)	2100 psi
Compressive Strength (28 day)	3000 psi
Cement Type	ASTM C150
Aggregate Size (maximum)	1.5 inch
Air Content	Do not use air entrainment for concrete mixes.
Slump	5 inches

C. Admixtures: Include admixture types and quantities indicated in concrete mix designs only when approved by Architect/Engineer.
   1. Use accelerating admixtures in cold weather. Use of admixtures will not relax cold weather placement requirements.
   2. Do not use calcium chloride nor admixtures containing calcium chloride.
   3. Use set retarding admixtures during hot weather.

D. Site Mixed Concrete: No site mixed concrete is allowed.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 013000 - Administrative Requirements: Coordination and project conditions.

B. Verify requirements for concrete cover over reinforcement.

C. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Remove laitance, coatings, and unsound materials.

B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

C. Remove debris and ice from formwork, reinforcement, and concrete substrates.

D. Remove water from areas receiving concrete before concrete is placed.

3.3 PLACING CONCRETE

A. Place concrete in accordance with ACI 301.

B. Notify testing laboratory and Architect/Engineer minimum 24 hours prior to commencement of operations.

C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, and are not disturbed during concrete placement.

D. Install vapor retarder under interior slabs on grade in accordance with ASTM E1643. Lap joints minimum 6 inches and seal watertight by adhesive applied between overlapping edges and ends as per manufacturer recommendations.

E. Repair vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum 6 inches and seal watertight.

F. Install construction joint devices in coordination with floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

G. Install joint device anchors. Maintain correct position to allow joint cover to be flush with floor finish.

H. Install joint covers in one piece longest practical length, when adjacent construction activity is complete.

I. Deposit concrete at final position. Prevent segregation of mix.

J. Place concrete in continuous operation for each panel or section determined by predetermined joints.

K. Consolidate concrete.

L. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

M. Place concrete continuously between predetermined expansion, control, and construction joints.

N. Do not interrupt successive placement; do not permit cold joints to occur.

O. Saw cut joints within 12 hours after placing. Use 3/16 inch thick blade, cut into 1/4 depth of slab thickness.

P. Screed floors and slabs on grade level, maintaining surface flatness of F_f of 35.

3.4 CONCRETE FINISHING

A. Finish concrete floor surfaces to requirements of Section 03350.

B. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains.

3.5 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
   1. Protect concrete footings from freezing for minimum 5 days.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

C. Cure floor surfaces as specified in Section 03390.

D. Ponding: Maintain 100 percent coverage of water over floor slab areas continuously for 7 days.

E. Spraying: Spray water over floor slab areas and maintain wet for 7 days.

3.6 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Field inspection and testing will be performed by Owner’s testing laboratory in accordance with ACI 318

C. Provide free access to Work and cooperate with appointed firm.

D. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.

E. Concrete Inspections:
   1. Continuous Placement Inspection: Inspect for proper installation procedures.
   2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.

F. Strength Test Samples:
   1. Sampling Procedures: ASTM C172.

2. Cylinder Molding and Curing Procedures: ASTM C31/C31M, cylinder specimens, standard cured field cured.
3. Sample concrete and make one set of three cylinders for every 150 cu yds or less of each class of concrete placed each day and for every 5,000 sf of surface area for slabs and walls.
4. When volume of concrete for any class of concrete would provide less than 3 sets of cylinders, take samples from three randomly selected batches, or from every batch when less than 3 batches are used.
5. Make one additional cylinder during cold weather concreting, and field cure.

G. Field Testing:
1. Slump Test Method: ASTM C143/C143M.
2. Air Content Test Method: ASTM C173/C173M.
3. Temperature Test Method: ASTM C1064/C1064M.
4. Measure slump and temperature for each compressive strength concrete sample.
5. Measure air content in air entrained concrete for each compressive strength concrete sample.

H. Cylinder Compressive Strength Testing:
1. Test Method: ASTM C39.
2. Test Acceptance: In accordance with ACI 318 .
3. Test one cylinder at 7 days.
4. Test two cylinders at 28 days.
5. Dispose remaining cylinders when testing is not required.

I. Core Compressive Strength Testing:
1. Sampling and Testing Procedures: ASTM C42/C42M.
2. Test Acceptance: In accordance with ACI 318.
3. Drill three cores for each failed strength test from concrete represented by failed strength test.

J. Water Soluble Chloride Ion Concentration Test Method: ASTM C1218; tested at 28 days.
1. Maximum Concentration: As permitted by applicable code.

K. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.

3.7 PATCHING

A. Allow Architect/Engineer to inspect concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Architect/Engineer upon discovery.

C. Patch imperfections as directed by Architect/Engineer

3.8 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. Repair or replacement of defective concrete will be determined by Architect/Engineer.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect/Engineer for each individual area.

3.9 SCHEDULE - CONCRETE TYPES AND FINISHES

A. Foundation Walls: 3,000 psi 28 day concrete, form finish with honeycomb filled surface.

B. Underside of Supported Floors and Structure Exposed to View: 4,000 psi 28 day concrete, sack rubbed finish.

C. Exposed Portico Structure: 4,000 psi 28 day concrete, air entrained, smooth stone rubbed finish.

3.10 SCHEDULE - JOINT FILLERS

A. Basement Floor Slab Perimeter:Joint filler Type A set 1/8 inch below floor slab elevation.

B. Exterior Retaining Wall at Loading Dock: Joint filler Type F recessed 3/8 inch with sealant cover.

END OF SECTION

SECTION 03 35 00 – CONCRETE FINISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Single application sealer-hardener for concrete floors.
   2. Accessories necessary for a complete installation.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's specifications, application instructions, and recommendations. Include data substantiating product complies with requirements of the contract documents.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Building Code: Comply with applicable requirements for the IBC for interior finishes.
   2. Accessibility Requirements: Comply with applicable requirements.
      a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
      b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
      c. Texas Accessibility Standards (TAS) 2012.

B. Manufacturer Qualifications: Provide products produced by a company specializing in production of concrete sealers for minimum of 5 years.

1.5 PROJECT CONDITIONS

A. Environmental Requirements: Do not proceed with installation until areas to receive work are enclosed and temperature and relative humidity are stabilized and maintained for optimum quality control.

B. Environmental Limitations: Comply with coating manufacturer's written instructions for substrate temperature, ambient temperature, humidity, ventilation, and conditions affecting floor treatment application. Do not apply coating until wet work in spaces is complete and dry; and overhead work, including installing mechanical systems, lighting, and athletic equipment, is complete.
   1. Apply floor coatings when substrate temperature and surrounding air temperatures are between 50 degrees F and 95 degrees F (10 degrees F and 35 degrees C).
   2. Do not apply floor coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F (3 degrees C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Specifications: Ashford Formula as manufactured by Curecrete Chemical Company. Subject to compliance with requirements, provide basis of design produce or comparable by one of the following:
   1. Evercrete Company.
   2. PROSOCO, Inc.
   3. WR Meadows.

B. Cure-Seal-Hardener: Water-based, chemically reactive penetrating sealer and hardener that densifies concrete to seal against water molecules, but allows air and water vapor to pass, so that concrete can achieve full compressive strength for minimized surface crazing and elimination of dusting.
   1. Abrasion Resistance to Revolving Disks: At least a 32.5% improvement over untreated samples when tested in accordance with ASTM C779.
   2. Surface Adhesion: At least a 22% increase in adhesion for epoxy when tested in accordance with ASTM D3359.
   3. Hardening: As follows when tested in accordance with ASTM C39:
      a. After 7 Days: An increase of at least 40% over untreated samples.
      b. After 28 Days: An increase of at least 38% over untreated samples.
   4. Coefficient of Friction: 0.86 dry, 0.69 wet when tested in accordance with ASTM C1028.
   5. Rebound Number: An increase of at least 13.3% over untreated samples when tested in accordance with ASTM C805.
   6. Light Exposure Degradation: No evidence of adverse effects on treated samples when tested in accordance with ASTM G23.

C. Edge Protection and Transition Strips:
   1. Sealed Concrete Floor to Gyp. Bd.: Schluter® - floor to wall transition strips in aluminum finish at all cove trim to gyp board wall transition locations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for conditions affecting performance and conditions of floor treatment.
   1. Verify compatibility with and suitability of substrates, including existing finishes or primers.
   2. Verify plasticizers in existing concrete substrate will not impair bond.
   3. Proceed with installation after correcting unsatisfactory conditions

3.2 PREPARATION

A. Clean substrate, removing chalk lines, pencil lines and other layout lines as well as projections and substances detrimental to the work; comply with recommendations of manufacturer of products to be installed for proper preparation procedures. Mask off or protect adjacent surfaces not scheduled to receive sealer.

3.3 APPLICATION

A. Spray apply sealer to comply with manufacturer's instructions except where project conditions require extra precautions or provisions to ensure satisfactory performance of the work.

1. Apply sealer to produce surface without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or surface imperfections. Produce sharp glass lines and color breaks.

3.1 CLEANING

A. After completing application, clean spattered surfaces. Remove spattered sealer by washing or other appropriate methods for coating. Do not scratch or damage adjacent finished surfaces.

B. Clean Up: Remove rubbish, empty cans, rags, and discarded materials from site daily. Rinse and recycle or legally dispose of sealer and coating containers.

3.2 PROTECTION

A. Institute protective procedures and install protective materials as required to ensure that work of this section will be without damage or deterioration at substantial completion.

END OF SECTION 03 35 00

SECTION 03 35 00

CONCRETE FINISHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Finishing concrete floors [and floor toppings].
2. Floor surface treatment.

B. Related Sections:
1. Section 033000 - Cast-in-Place Concrete: [Prepared concrete floors ready to receive finish;] [control and formed expansion and contraction joints and joint devices].
2. Section 03360 - Concrete Finishes: Exposed aggregate finish.
3. Section 033900 - Concrete Curing.
4. Section 079513 - Expansion Joint Cover Assemblies.
5. Section 079200 - Joint Sealers.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 301 - Specifications for Structural Concrete.
2. ACI 302.1 - Guide for Concrete Floor and Slab Construction.

B. ASTM International:
1. ASTM E1155 - Standard Test Method for Determining Floor Flatness and of Levelness Using the F-number System.

1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on concrete hardener, sealer, curing compounds curing papers and slip resistant treatment, compatibilities, and limitations.

1.4 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit data on maintenance renewal of applied coatings.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301 and ACI 302.1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Product storage and handling requirements.

B. Deliver materials in manufacturer's packaging including application instructions.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Section 016000 - Product Requirements: Environmental conditions affecting products on site.

1.8 COMPOUNDS - HARDENERS AND SEALERS

A. Chemical Hardener: Magnesium fluorosilicate and zinc fluorosilicate blend

PART 2 EXECUTION

2.1 EXAMINATION

A. Section 013000 - Administrative Requirements: Coordination and project conditions.

B. Verify floor surfaces are acceptable to receive the Work of this section.

2.2 FLOOR FINISHING

A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.1.

B. Wood float surfaces receiving quarry tile, ceramic tile, and cementitious terrazzo with full bed setting system.

C. Steel trowel surfaces receiving carpeting, resilient flooring, seamless flooring, thin set terrazzo, thin set quarry tile, and thin set ceramic tile.

D. Steel trowel surfaces which are scheduled to be exposed.

2.3 TOLERANCES

A. Section 014000 - Quality Requirements: Tolerances.

B. Measure for F(F) and F(L) tolerances for floors in accordance with ASTM E1155, within 48 hours after slab installation.

C. Finish concrete to achieve the following tolerances:
1. Under Glazed Tile on Setting Bed: F(F) 35 and F(L) 20.
2. Under Resilient Finishes: F(F) 75 and F(L) 50.
3. Exposed to View and Foot Traffic: F(F) 75 and F(L) 40.
4. Correct slab surface when actual F(F) or F(L) number for floor installation measures less than required.

D. Correct defects in defined traffic floor by grinding or removal and replacement of defective Work. Areas requiring corrective Work will be identified. Re-measure corrected areas by same process.

END OF SECTION

SECTION 03 35 43 - POLISHED CONCRETE FINISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Polished concrete finishing.
   2. Staining.
   3. Accessories necessary for a complete installation,

1.3 SUBMITTALS

A. Product Data: Technical data for each type of product including special concrete finishes, data sheets, and manufacturer's installation instructions.

B. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.

C. Samples: Submit samples of each type of exposed color showing anticipated variegation of color.

D. Test Reports: Submit test reports or certification from NFSI confirming that polished concrete floor finish has been tested in accordance with Method 101A and has passed phase 2 level of certification

E. Qualification Data: Submit one copy of Installer's qualifications.

F. Material Certificates: Submit materials certificates signed by manufacturer for the following products.
   1. Repair materials.
   2. Stain materials.
   3. Liquid floor treatments.

G. Maintenance Data: Submit manufacturer's recommended cleaning and maintenance instructions for polished concrete floor finish.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Building Code: Comply with applicable requirements for the IBC for interior finishes.
   2. Accessibility Requirements: Comply with applicable requirements.
      a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
      b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
      c. Texas Accessibility Standards (TAS) 2012.

B. Manufacturer Qualifications: Provide products produced by a company specializing in production of special concrete finishes concrete for minimum of 5 years.

C. Installer Qualifications: Installer having minimum 5 years documented experience, who specializes in the finishing of concrete substrates, and who is certified by manufacturer as an installer of special concrete finishes.

D. Field Sample Panels: After approval of verification sample and before casting concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full scale panels, approximately 48 by 48 inches (1200 by 1200 mm) minimum, to demonstrate the expected range of finish, color, and appearance variations.
   1. Locate panels as indicated or, if not indicated, as directed by Architect.
   2. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
   3. Demolish and remove field sample panels when directed.

E. Mockups: Before casting concrete, build mockups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
   1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
   2. Demonstrate curing, finishing, and protecting of polished concrete.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at site.
   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with polished concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready mix concrete manufacturer.
      d. Cast in place concrete subcontractor.
      e. Polished concrete finishing Subcontractor.

   2. Review cold and hot weather concreting procedures, curing procedures, construction joints, concrete repair procedures, concrete finishing, and protection of polished concrete.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original containers, with seals unbroken, bearing manufacturer labels indicating brand name and directions for storage.

B. Dispense special concrete finish material from factory numbered and sealed containers. Maintain record of container numbers.

1.6 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic necessary for other construction activities.

B. Environmental limitations:
   1. Comply with manufacturer’s written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and conditions affecting topping performance.
   2. Concrete Flatness:
      a. Floor Flatness Rating: Minimum FF40.
      b. Floor Levelness Rating: Minimum FL 40.

3. Curing: Minimum of 28 days or as directed by the manufacturer before application.
4. Apply stain minimum 10 days prior to installation of equipment and substantial completion, ensuring uninhibited concrete slab.
5. Close areas to traffic during floor application and after application, for time period recommended in writing by manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Densifying and Sealing Treatment.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Dayton Superior.
      b. Laticrete – FGS Permashine.
      c. Lythic Solutions, Inc.
      d. Retroplate – Retroplate 99.
      e. WR Meadows – Liqui-Hard.

B. Reactive Stain: Acidic based stain with wetting agents and high grade, UV stable metallic salts that react with calcium hydroxide in cured concrete to produce permanent, variegated, or translucent color effects.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Bomanite Co.
      b. Increte Systems Inc.
      c. Scofield, L. M. Company.
      d. Specialty Concrete Products, Inc.
      e. Stampcrete International, Ltd.

C. Penetrating Stain: Water based, acrylic latex, penetrating stain with colorfast pigments.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Bomanite Co.
      b. Scofield, L. M. Company.
      c. SuperStone, Inc.

D. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Advanced Floor Products.
      b. Euclid Chemical Company (The); an RPM company.
      c. L&M Construction Chemicals, Inc.
      d. Vexcon Chemicals Inc.

C. Edge Protection and Transition Strips:
   1. Sealed Concrete Floor to Gyp. Bd.: Schluter® - floor to wall transition strips in aluminum finish at all cove trim to gyp board wall transition locations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate for conditions affecting performance of finish. Correct conditions detrimental to timely and proper work.
   1. Verify that slab complies with finish and surface profile requirements.
   2. Prior to application, verify concrete floor surfaces are free of laitance and construction materials.
   3. Verify concrete has been in place a minimum of 28 days prior to the commencement of application.
   4. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Deliver materials to site in original, factory sealed, unopened, new containers bearing manufacturer's name and label intact and legible, with the following information:
   1. Name or title of material.
   2. Manufacturer's standard container drum numbers.
   3. Thinning instructions.
   4. Application instructions.

B. Storage: Store materials in protected and well-ventilated area at temperatures between 40 degrees F. and 90 degrees F unless otherwise required by manufacturer.
   1. Keep containers sealed until ready for use.
   2. Do not use materials beyond manufacturer's shelf life limits.

C. Existing Concrete: On existing concrete substrates, remove mastics, adhesives, paint, and foreign matter.
   1. Clean concrete surfaces free of dirt, debris, paint/oil splatters and other residue.
   2. Remove curing compounds and sealers from concrete surfaces.
   3. Leave concrete surfaces clean and dry, ready for polishing process.
   4. Protect adjacent surfaces and finishes from damage by concrete polishing procedures.
   5. Fill control joints and shave prior to grinding and polishing.

D. New Concrete: Verify new concrete has been in place for a minimum of 30 days.

3.3 STAINING

A. Prepare surfaces according to manufacturer's written instructions and as follows:
   1. Clean concrete thoroughly by scraping, applying solvents or stripping agents, sweeping and pressure washing, or scrubbing with rotary floor machine and detergents recommended by stain manufacturer. Rinse until water is clear and allow surface to dry.
      a. Do not use acidic solutions to clean surfaces.

   2. Test surfaces with droplets of water. If water beads and does not penetrate surface, or penetrates only in some areas, profile surfaces by grinding, sanding, or abrasive blasting. Retest and continue profiling surface until water droplets immediately darken and uniformly penetrate concrete surfaces.
   3. Apply acidic solution to dampened concrete surfaces, scrubbing with uncolored, acid resistant nylon bristle brushes until bubbling stops and concrete surface has texture of 120 grit sandpaper. Do not allow solution to dry on concrete surfaces. Rinse until water is clear. Control, collect, and legally dispose of runoff.
   4. Neutralize concrete surfaces and rinse until water is clear. Test surface for residue with clean white cloth. Test surface according to ASTM F 710 to ensure pH is between 7 and 8.

B. Scoring: Score decorative jointing in concrete surfaces 1/16 inch (1.6 mm) deep with diamond blades to match pattern indicated. Rinse until water is clear. Score after staining.
   1. Joint Width: 3/8 inch (10 mm).

C. Allow concrete surface to dry before applying stain. Verify readiness of concrete to receive stain according to ASTM D 4263 by tightly taping 18 inch by 18 inch (450 mm by 450 mm), 4 mil (0.1 mm) thick polyethylene sheet to a representative area of concrete surface. Apply stain only if no evidence of moisture has accumulated under sheet after 16 hours.

D. Reactive Stain: Apply reactive stain to concrete surfaces according to manufacturer's written instructions and as follows:
   1. Apply stain by uncolored bristle brush, roller, or high volume, low pressure sprayer and immediately scrub into concrete surface with uncolored, acid resistant nylon bristle brushes in continuous, circular motion. Do not spread stain after fizzing stops. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
   2. Remove stain residue after four hours by wet scrubbing with commercial-grade detergent recommended by stain manufacturer. Rinse until water is clear. Control, collect, and legally dispose of runoff.

E. Penetrating Stain: Apply penetrating stain to concrete surfaces according to manufacturer's written instructions and as follows:
   1. Apply first coat of stain to dry, clean surfaces by airless sprayer or by high-volume, low-pressure sprayer.
   2. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
   3. Rinse until water is clear. Control, collect, and legally dispose of runoff.

3.4 PREPARATION

A. Cover and protect merchandise and racking to prevent damage or contamination of stored products. Provide dust drapes as required to protect merchandise from dust or debris.

B. Close areas to traffic during and after floor finish application for time period recommended by hardener/densifier manufacturer.

C. Cleaning Substrate: Remove curing, sealing and coating agents, oil, breaking compound residue, wax, and grease by scraping off heavy deposits mechanically or chemically to assure penetration of product into surface.
   1. Remove mildew by scrubbing with solution of trisodium phosphate and bleach. Rinse with clean water.
   2. Remove dust and loose material by brushing, sweeping, vacuuming, and blowing with high pressure air.
   3. Remove paint residue with solvent/stripper provided the stripper does not have an acidic pH.
   4. Remove tire marks and residue with recommended non-acidic cleaning agents.
      a. Comply with manufacturer’s detailed instructions prior to mixing and removal.

      b. Dilute cleaning agent in recommended proportions to avoid etching concrete and opening of concrete pores.

   5. Power scrub and rinse floor surface to remove soap residue and contaminants.
   6. Squeegee dry.
   7. No hazardous, flammable, toxic or solvent based cleaning materials are permitted.

D. Grind protrusions flush with surface. Patch voids, holes and cracks with recommended cementitious patching compound compatible with floor finish.

E. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and contaminants.

F. Protect surrounding and adjacent surfaces in accordance with floor finish manufacturer's written recommendations. Do not apply tape to the floor.

3.5 POLISHING

A. Apply concrete polishing in accordance with manufacturer's instructions to the selected sheen level.

A. Polish: [**Level 1: Matte finish, 100 grit**] [**Level 2: Low sheen, 400 grit**] [**Level 3: High sheen, 800 grit**] [**Level 4: Gloss shine, 3000 grit**].

B. Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
   1. Grind concrete floor to within 5 inches of walls and partitions using SF-40 grit, removing construction debris and floor slab imperfections and imparting a uniform scratch pattern in concrete surfaces. Thoroughly vacuum floor using a squeegee vacuum attachment to completely remove dust and debris
   2. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
   3. Apply reactive stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
   4. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time, approximately two hours, between successive coats. Remove excess material from surfaces.
   5. Grind concrete floor to within 5 inches of walls and partitions using metal bonded diamond grits in a finer grit for each polishing, grinding 90 degrees from each previous grind and removing scratches from each previous grind. After each grind, thoroughly vacuum floor using a squeegee vacuum attachment to completely remove dust and debris.
   6. Apply penetrating stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
   7. Continue polishing with progressively finer grit diamond polishing pads to gloss level, to match approved mockup.
   8. Control and dispose of waste products produced by grinding and polishing operations.
   9. Neutralize and clean polished floor surfaces.

C. Completed polished concrete floor shall have uniform sheen level and shall match accepted mock-up

END OF SECTION 03 35 43

SECTION 03 39 00

CONCRETE CURING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes initial and final curing of horizontal and vertical concrete surfaces.

B. Related Sections:
1. Section 033000 - Cast-In-Place Concrete.
2. Section 033500 - Concrete Finishing.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 301 - Specifications for Structural Concrete.
2. ACI 302.1 - Guide for Concrete Floor and Slab Construction.
3. ACI 308.1 - Standard Specification for Curing Concrete.
4. ACI 318 - Building Code Requirements for Structural Concrete.

B. ASTM International:
1. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
2. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
3. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
4. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting.

1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on curing compounds, mats, paper, film, compatibilities, and limitations.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

PART 2 PRODUCTS

2.1 MATERIALS

A. Membrane Curing Compound Type 1.

B. Membrane Curing Compound: ASTM C1315 Type I.

C. Water: Potable, not detrimental to concrete.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 013000 - Administrative Requirements: Coordination and project conditions.

B. Verify substrate surfaces are ready to be cured.

3.2 INSTALLATION - HORIZONTAL SURFACES

A. Cure concrete in accordance with ACI 308.1.

B. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for 4 days.

****** [OR] ******

C. Spraying: Spray water over floor slab areas and maintain wet for 7 days.

****** [OR] ******

D. Absorptive Mat: Spread cotton fabric over floor slab areas. Spray with water until mats are saturated, and maintain in saturated condition for 7 days.

****** [OR] ******

E. Absorptive Mat: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place for 7 days.

3.3 PROTECTION OF FINISHED WORK

A. Section 017000 - Execution Requirements: Protecting finished Work.

B. Do not permit traffic over unprotected floor surface.

3.4 SCHEDULES

A. Storage Area Slabs: Absorptive mats, burlap-polyethylene type.

B. Retaining Walls: Membrane curing compound, acrylic type, clear color.

C. Concrete Pavement: Membrane curing compound, opaque color.

D. Other Floor Areas: Membrane curing compound, acrylic type, translucent color.

END OF SECTION

SECTION 03 60 00

GROUT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Portland cement grout.
2. Rapid curing epoxy grout.
3. Non-shrink cementitious grout.

B. Related Sections:
1. Section 033000 - Cast-in-Place Concrete.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 301 - Specifications for Structural Concrete.
2. ACI 318 - Building Code Requirements for Structural Concrete.

B. American Society of Testing and Materials:
1. ASTM C33 - Standard Specification for Concrete Aggregates.
2. ASTM C40 - Test Method for Organic Impurities in Fine Aggregates for Concrete.
3. ASTM C150 - Standard Specification for Portland Cement.
4. ASTM C191 - Test Method for Time of Setting of Hydraulic Cement by Vicat Needle.
5. ASTM C307 - Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings.
6. ASTM C531 - Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
7. ASTM C579 - Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, monolithic Surfacings and Polymer Concretes.
8. ASTM C827 - Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.

C. U. S. Army Corps of Engineers Concrete Research Division (CRD):
1. CRD C621 - Non-Shrink Grout.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT GROUT MATERIALS

A. Portland Cement: ASTM C150, Type I and II.

B. Water:
1. Potable; containing no impurities, suspended particles, algae or dissolved natural salts in quantities capable of causing:

a. Corrosion of steel.
b. Volume change increasing shrinkage cracking.
c. Efflorescence.
d. Excess air entraining.

C. Fine Aggregate:
1. Washed natural sand.
2. Gradation in accordance with ASTM C33 and represented by smooth granulometric curve within required limits.
3. Free from injurious amounts of organic impurities as determined by ASTM C40.

D. Mix:
1. Portland cement, sand and water. Do not use ferrous aggregate or staining ingredients in grout mixes.

2.2 RAPID CURING EPOXY GROUT

A. Rapid Curing Epoxy Grout: High strength, three component epoxy grout formulated with thermosetting resins and inert fillers. Rapid-curing, high adhesion, and resistant to ordinary chemicals, acids and alkalies.

Compressive Strength	ASTM C579	12,000 psi at 7 days
Tensile Strength	ASTM C307	2,000 psi minimum
Coefficient of Expansion	ASTM C531	30x10-6 in per degree F
Shrinkage	ASTM C827	None

2.3 NON-SHRINK CEMENTITIOUS GROUT

A. Properties: Certified to maintain initial placement volume or expand after set and meet the following minimum properties when tested in accordance with CRD-C621, for Type D non-shrink grout:

Property	Test	Time	Result
Setting Time	ASTM C191	Initial	2 hours (Approx)
		Final	3 hours (Approx)
Expansion			0.10% - 0.4% Maximum
Compressive Strength	CRD-C621	1 day	4,000 psi
		7 days	7,000 psi
		28 days	10,000 psi to 10,800 psi

2.4 FORMWORK

A. Refer to Section 031000 for formwork requirements.

2.5 CURING

A. Prevent rapid loss of water from grout during first 48 hours by use of approved membrane curing compound or with use of wet burlap method.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until sound, clean concrete surface is achieved.

B. Rough concrete lightly, but not enough to interfere with placement of grout.

C. Remove foreign materials from metal surfaces in contact with grout.

D. Align, level and maintain final positioning of components to be grouted.

E. Saturate concrete surfaces with clean water; remove excess water, leave none standing.

3.2 MIXING

A. Portland Cement Grout:
1. Use proportions of 2 parts sand and 1 part cement, measured by volume.
2. Prepare grout with water to obtain consistency to permit placing and packing.
3. Mix water and grout in two steps; pre-mix using approximately 2/3 of water;after partial mixing, add remaining water to bring mix to desired placement consistency and continue mixing 2 to 3 minutes.
4. Mix only quantities of grout capable of being placed within 30 minutes after mixing.
5. Do not add additional water after grout has been mixed.
6. Capable of developing minimum compressive strength of 2400 psi in 48 hours and 7000 psi in 28 days.

****** [OR] ******

3.3 PLACING GROUT

A. Place grout material quickly and continuously.

B. Do not use pneumatic-pressure or dry-packing methods.

C. Apply grout from one side only to avoid entrapping air.

D. Do not vibrate placed grout mixture, or permit placement when area is being vibrated by nearby equipment.

E. Thoroughly compact final installation and eliminate air pockets.

F. Do not remove leveling shims for at least 48 hours after grout has been placed.

3.4 CURING

A. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. After grout has attained its initial set, keep damp for minimum of 3 days.

3.5 FIELD QUALITY CONTROL

A. Submit proposed mix design of each class of grout to inspection and testing firm for review prior to commencement of Work.

B. Tests of grout components may be performed to ensure conformance with specified requirements.

END OF SECTION

SECTION 04 05 14

MASONRY MORTAR AND GROUT

PART 1 GENERAL

1.1 SUMMARY

A. Section includes mortar and grout for masonry.

B. Related Sections:
1. Section 042000 - Unit Masonry Assemblies: Installation of mortar and grout.
2. Section 042016 - Reinforced Unit Masonry Assemblies: Installation of mortar and grout.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 530 - Building Code Requirements for Masonry Structures.
2. ACI 530.1 - Specifications for Masonry Structures.

B. ASTM International:
1. ASTM C5 - Standard Specification for Quicklime for Structural Purposes.
2. ASTM C91 - Standard Specification for Masonry Cement.
3. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
4. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
5. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
6. ASTM C150 - Standard Specification for Portland Cement.
7. ASTM C199 - Standard Test Method for Pier Test for Refractory Mortars.
8. ASTM C206 - Standard Specification for Finishing Hydrated Lime.
9. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
10. ASTM C387 - Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
11. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
12. ASTM C476 - Standard Specification for Grout for Masonry.
13. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
14. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
15. ASTM C1019 - Standard Test Method for Sampling and Testing Grout.
16. ASTM C1142 - Standard Specification for Extended Life Mortar for Unit Masonry.
17. ASTM C1314 - Standard Test Method for Constructing and Testing Masonry Prisms Used to Determine Compliance with Specified Compressive Strength of Masonry.
18. ASTM C1329 - Standard Specification for Mortar Cement.
19. ASTM C1357 - Standard Test Method for Evaluating Masonry Bond Strength.

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal requirements.

B. Design Data: Submit design mix when Property specification of ASTM C270 is to be used, required environmental conditions, and admixture limitations.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 530 and ACI 530.1.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Section 016000 - Product Requirements.

B. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F.

C. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

PART 2 PRODUCTS

2.1 COMPONENTS

A. Portland Cement: ASTM C150, Type I

B. Calcium chloride is not permitted.

2.2 MIXES

A. Mortar Mixes:
   1. Extended Life Mortar: ASTM C1142, Type RS

B. Mortar Mixing:
   1. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use.
   2. Achieve uniformly damp sand immediately before mixing process.
   3. Re-temper only within two hours of mixing.

C. Grout Mixes:
   1. Grout for Non-Structural Masonry: 3,000 psi strength at 28 days; 8-11 inches slump; mixed in accordance with ASTM C476 grout.
   2. Grout for Structural Masonry: 3,000 psi strength at 28 days; 8-11 inches slump; mixed in accordance with ASTM C476 grout.
   3. Application:
      a. Coarse Grout: For grouting spaces with minimum 4 inches dimension in every direction.
      b. Fine Grout: For grouting other spaces.

D. Grout Mixing:

1. Mix grout in accordance with ASTM C94/C94M, modified to use ingredients complying with ASTM C476.
2. Add admixtures; mix uniformly.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 013000 - Administrative Requirements: Coordination and project conditions.

B. Request inspection of spaces to be grouted.

3.2 INSTALLATION

A. Install mortar and grout in accordance with ACI 530.1 Specifications for Masonry Structures.

3.3 FIELD QUALITY CONTROL

A. Establishing Mortar Mix: In accordance with ASTM C270.

B. Testing Frequency: One set of specified tests for every 5,000 sf of completed wall area.

C. Testing of Mortar Mix: In accordance with ASTM C780 for aggregate ratio and water content, air content, consistency, and compressive strength.

D. Testing of Grout Mix: In accordance with ASTM C1019 for compressive strength, and in accordance with ASTM C143/C143M for slump.

E. Test compressive strength of mortar and masonry to ASTM C1314; test in accordance with masonry unit sections specified.

END OF SECTION

SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Concrete masonry units (CMU)

B. Face brick, including solids.

1.3 DEFINITIONS

A. CMU: Concrete masonry unit.

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 RELATED WORK

A. Section 01 45 23 - Testing and Inspecting Services.

B. Section 05 50 00 – Metal Fabrications. Steel masonry lintels.

C. Section 07 21 00 – Thermal Insulation.

D. Section 07 92 00 – Joint Sealants.

E. Section 09 90 00 – Paintings and Coatings.

F. All Sections of Work built-in, adjacent to, or applied to unit masonry work.

1.5 REFERENCES

A. ASTM International (ASTM)
1. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron & Steel Hardware.
2. A307 - Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
3. A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
4. A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
5. C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
6. C90 - Standard Specification for Loadbearing Concrete Masonry Units.
7. C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units.
8. C144 - Standard Specification for Aggregate for Masonry Mortar.
9. C150, Standard Specification for Portland Cement.
10. C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
11. C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
12. C270 - Standard Specification for Mortar for Unit Masonry.
13. C331 - Standard Specification for Lightweight Aggregates for Concrete Masonry Units.
14. C332 - Standard Specification for Lightweight Aggregates for Insulating Concrete.
15. C404 - Standard Specification for Aggregates for Masonry Grout.

16. C476 - Standard Specification for Grout for Masonry.
17. C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
18. C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale).
19. C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
20. C979 - Standard Specification for Pigments for Integrally Colored Concrete.
21. D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
22. D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
23. E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

B. Underwriters' Laboratories, Inc. (UL)

1.6 QUALITY ASSURANCE

A. Where requirements of this Section are in conflict with requirements noted on the Structural Drawings, the Structural Drawings shall take precedence. Refer to Structural Drawings for information on load-bearing CMU walls.

B. Fire Performance Characteristics: Where indicated or required, provide materials and construction which are identical to assemblies whose fire endurance has been determined by testing in compliance with ASTM E119 by U.L. or other recognized testing and inspection organization or by other means, acceptable to authority having jurisdiction.

C. Masonry Cleaning: Workers shall have minimum 5 years of masonry cleaning experience, and shall be approved by cleaner manufacturer prior to application of cleaning material, and shall meet with cleaner manufacturer for demonstration and instruction s for use of product prior to application.

D. Perimeter Walk-Around: Daily perimeter walk-around the exterior side of the masonry by the GC and or masonry Subcontractor at the end of each work day as a visual inspection looking for obvious issues or flaws concerning colors, finishes, workmanship, protection of Work.

E. Single Source Responsibility:
   1. For Masonry Units: Obtain masonry units of uniform texture and color, or a uniform blend within the accepted ranges for those characteristics, from one (1) manufacturer for each different product required for each continuous surface or visually related surfaces.
   2. For Mortar and Grout Materials: Brands of cementitious materials and admixtures, and the source of supply of sand and aggregates shall remain the same throughout the Work where exposed to view and where not scheduled to receive a subsequently applied finish, i.e. parging, painting, etc., unless directed otherwise in writing by the Architect.
   3. Contractor's Responsibility: Contractor performing Work of this Section shall be responsible for coordinating with others performing work which is built-in or adjacent to unit masonry work.

1.7 SUBMITTALS

A. Product Data: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

B. Samples: Two (2) sets of color chips representing manufacturer's full range of available colors and textures of each face brick for Architect's selection and approval.

C. Sample Panel(s):

1. Do not start masonry until Architect has approved samples.
2. Sample panel shall be 6 feet long by 8 feet high showing selected color range and texture, bonding, joint shape, and quality of workmanship. Include a brick and expansion joint, and any specialty details, such as reveals, soldier courses, etc. Include mock-up of installation of thru-wall flashing at foundation sill and lintel above openings, window jambs and sills.
3. A separate panel for each type of masonry used is required.
   Sample panel(s) shall remain at the jobsite until all masonry is completed.
   Installed materials shall be visible and integrated into adjacent materials.
4. Brace and support as required to withstand structural wind loads.

D. Certification: Submit manufacturer's affidavit that materials used in Project contain no asbestos.

E. Mortar and Grout Mix Designs: Submit two (2) copies of proposed mortar and grout mix designs to Owner's testing laboratory.

1.8 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 00 – Project Management and Coordination.

1.9 MOCKUPS

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Build mockups for each type of exposed unit masonry construction in sizes approximately 72 inches (1800 mm) long by 72 inches (1800 mm) high by full thickness, including face and backup wythes and accessories.
      a. Include a sealant filled joint at least 16 inches (400 mm) long in each mockup.
      b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches (300 mm) wide by 16 inches (400 mm) high.
      c. Include through wall flashing installed for a 24 inch (600 mm) length in corner of exterior wall mockup approximately 16 inches (400 mm) down from top of mockup, with a 12 inch (300 mm) length of flashing left exposed to view (omit masonry above half of flashing).
      d. Include metal studs, sheathing, water resistive barrier, sheathing joint and penetration treatment, air barrier, veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry veneer wall mockup.
   2. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
   3. Clean one/half of exposed faces of mockups with masonry cleaner as indicated.
   4. Protect accepted mockups from the elements with weather resistant membrane.
   5. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
      a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
      b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   6. Subject to compliance with requirements, approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.

1.10 TESTS AND INSPECTIONS

A. Materials and installation of masonry shall be subject to testing and inspection by an independent testing laboratory. Such tests and inspections shall not relieve Contractor of responsibilities for providing materials and procedures which comply with Contract Documents. Promptly remove and replace materials which do not comply.

B. Owner will select Inspection and Testing Laboratory and will pay for all Work required by Inspection and Testing Laboratory.

1.10 DELIVERY, STORAGE AND PROTECTION

A. Deliver and store materials in dry protected areas off ground. Keep free of stain or other damage before, during and after installation. Replace any damaged material at no cost to Owner.

B. During freezing weather, protect masonry units with tarpaulins or other suitable material. Keep free of stain or other damage before, during and after installation. Replace damaged material at no cost to Owner.

C. Protect reinforcement and accessories from elements.

1.11 SITE CONDITIONS

A. Cold Weather Protection:
   1. No masonry shall be laid when the temperature of the outside air is below 40 degrees F, unless protection measures are employed and pre-approved by the Architect.
   2. Protection measures for cold weather erection include maintaining space and masonry unit temperatures of at least 40 degrees F for 48 hours prior to and after erection.

B. Hot Weather Protection:
   1. When the mean daily temperature exceeds 100 degrees F or exceeds 90 degrees F with a wind velocity greater than 8 mph, fog spray all newly constructed masonry until damp, at least three (3) times a day until the masonry is three (3) days old.

1.12 BRACING OF MASONRY DURING ERECTION

A. All masonry shall be adequately braced at all times during erection.

1.13 COORDINATION

A. Openings and chases for heating, plumbing, electrical ducts, pipes, and conduits shall be built into masonry walls as required. Provide for installation of bolts, toggles, flashings, beams, anchors, hangers, nailing strips, wall plugs, and frames as required. Consult other trades in advance and make provisions for installation of their work to avoid cutting and patching. Coordinate installation of steel reinforcement for reinforced masonry. Coordinate placement of concrete in masonry beams, lintels, soffits, and pilasters.

1.14 WARRANTY

A. Warrant the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.

B. Defects shall include, but not be limited to, the following:
   1. Noticeable deterioration of unit or mortar finish.
   2. Chalking or dusting excessively.
   3. Changing color in irregular fashion.

4. Cracking or spalling.
5. Releasing from substrate.
6. Staining or discoloring, including efflorescence.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Specifications are based on products of manufacturers named within the specifications. Other manufacturers must have a minimum of five (5) years experience manufacturing products equal to those specified and comply with requirements of Division 1 regarding substitutions to be considered.
   1. Face Brick Manufacturers: Subject to compliance with requirements, provide products of one of the following:
      a. Texas Collection.
      b. Sioux City Brick.
      c. Forterra.
      d. Kansas Brick and Tile.
      e. Comparable Product.

   2. Concrete Masonry Units (CMU/Block) Manufacturers: Subject to compliance with requirements, provide products of one of the following:
      a. Boral Industries Company (Formerly Headwaters Construction Products).
      b. Featherlite Building Products.
      c. Texas Building Products, Inc.
      d. Revels Block & Brick Co., Inc.

2.2 MATERIALS

A. Concrete Masonry Units (CMU/Block):
   1. Type/Sizes:
      a. Concealed cavity block block, unless otherwise noted: Regular smooth face units with 8 inch by 16 inch face dimensions as shown on drawings or required, 4 inch, 6 inch, and 8 inch depths as indicated on drawings.
         1) Color: Standard.

   2. Integral Water Repellant (In exterior exposed CMU): “Dry-Block Block Admixture” integral water repellant admixture as manufacturer by Grace Construction Packaging (gcp), or equal.
   3. Specification: Comply with ASTM C90 (Class D-2 (2 hour) and Class B-4 (4 hour)) block at rated walls).
      a. Grade: Type N, highest standard for typical cavity block use. Type S, for exterior exposed masonry walls.
      b. Aggregate: Lightweight in accordance with ASTM C331.

   4. Curing: Rotary kiln process.
   5. Provide bullnose units at all outside corners.
   6. Provide bond beams, control joints, jambs, lintels, soaps, cap blocks, and fillers to match and compliment block units as shown or required.

B. Face Brick: King Size face brick complying with the requirements of ASTM C216, Grade SW, Type FBX as selected by Architect including solids and special shapes as indicated or required (all colors).

C. Mortar:
   1. Materials: (Unless stated otherwise on Structural Drawings)

a. Portland Cement: ASTM C150, Type 1.
b. Hydrated Lime: ASTM C207, TYPE “N”, typical. Use TYPE “S” for load-bearing masonry.
c. Aggregate: Sand conforming to ASTM C144.
d. Water: Clean and potable.
e. Admixtures For Mortar:
   1) General: Do not use calcium chloride
   2) Concrete Masonry Units: Spectrum Mortar Color or Architect approved equal.
   3) Face Brick: Spectrum Mortar Color or Architect approved equal.
   4) Integral Water Repellant (In mortar of exterior exposed CMU): “Dry- Block Mortar Admixture” integral water repellant admixture as manufacturer by Grace Construction Packaging (gcp) or equal. Note: Water repellent block admixture and mortar admixture are not interchangeable.

2. Mix Design: (Proportions by volume) (Unless stated otherwise on Structural Drawings)
   a. Typical, Non-load bearing masonry
      1) Type: ASTM C270, Type “N.”
      2) Proportions: 1 part cement, 1 part hydrated lime and 6 parts sand to provide a compressive strength of 750 psi in 28 days. Do not use calcium chloride.

   b. Load bearing structural masonry
      1) Type: ASTM C270, Type “S.”
      2) Proportions: 1 part cement, 1/2 part hydrated lime and 4-1/2 parts sand to provide a compressive strength of 1800 psi in 28 days. Do not use calcium chloride.

D. Grout:
1. Materials: (Unless stated otherwise on Structural Drawings)
   a. Hydrated Lime: ASTM C207, TYPE “S.”
   b. Portland Cement: ASTM C150, Type 1.
   c. Water: Clean and potable
   d. Aggregates:
      1) Course aggregate shall conform to ASTM C404.
      2) Fine aggregate shall conform to ASTM C144.

2. Mix Design: (Unless stated otherwise on Structural Drawings)
   a. Comply with ASTM C476 to provide a compressive strength of 2,500 psi in 28 days, unless noted otherwise. Do not use calcium chloride.
      1) Fine Grout: Fine grout conforming to ASTM C476 and consisting of 1 part Portland cement, 0 to 1/10 part lime and 2-1/4 to 3 parts sand by volume.
      2) Course Grout Mix: Course grout conforming to ASTM C476 and consisting of 1 part Portland cement, 0 to 1/10 part lime and 2-1/4 to 3 parts sand, and 1 to 2 parts course aggregate.

E. Reinforcement, Anchors and Tie Systems:
1. General: Reinforcement used in all wythes shall be galvanized after fabrication in accordance with ASTM A153, Class B-2.
2. Approved Manufacturers include the following:
   a. Heckmann Building Products
   b. Hohmann & Barnard, Inc
   c. Wire-Bond

3. At solid multiple wythe masonry walls and single wythe masonry walls, use #9 gauge truss type reinforcing. Pre-fab corners and tees shall be used at all wall corners and intersections; width shall be two (2) inches less than nominal thickness of walls. Hohmann

& Barnard "120 Truss-Mesh" at single wythe; "230 Ladder-Tri-Mesh" at multiple, or Architect approved equal.

4. At Double Wythe Cavity Walls with Insulation Board: Use Hot-dipped galvanized, #9 gauge truss type with 3/16 inch adjustable pintle wall ties. Width of truss reinforcement shall be 2 inches less than the nominal thickness of wall. 3/16 inch wall tie double eye sections welded at 16 inches o.c. extended as required for insulation thickness. Pre fab corners and tees shall be used at all wall corners and intersections. Hohmann & Barnard "270 Ladder Eye-Wire", or Architect approved equal.
5. At Masonry Anchored to Steel Spandrel Beam and Columns: Hot-dipped galvanized, No. 315 Anchor and No. 316 Pintle Tie manufactured by Heckmann Building Products, Inc., or Architect approved equal. Anchors detailed on Structural Drawings supersede.
6. At Veneer Brick Anchored to Light Gauge Steel Framing: Hot-dipped galvanized, No. 75HE Pos-i-Tie System utilizing self-tapping screw for steel studs with 5/8 inch barrel length, and 4 inch triangle wire tie for 2 inch cavity manufactured by Heckmann Building Products, Inc., or Architect approved equal. Anchors detailed on structural drawings supersede. Attachment screws shall be corrosion resistant type as recommended by manufacturer to suit application. Adjust wire tie size as required to conform with cavity depth if other than 2 inch.
7. Control Joint Anchor: Equal to Heckmann Building Products, Inc. No. 351 Anchor.
8. Corrugated Wall Tiles: Not acceptable under any circumstances.

F. Precast Concrete U-Lintels (Contractors Option to site built masonry lintels)
   1. Concrete Materials:
      a. Portland Cement: ASTM C150 Type I or III, gray color.
      b. Aggregates: ASTM C33.
      c. Water: potable
      d. Admixtures: Shall not contain calcium chloride or chloride ions

   2. Reinforcing:
      a. Deformed Reinforcement: ASTM A615 Grade 40 or 60.
      b. Prestressing Strand: ASTM A416 270 ksi LL.

   3. Fabrication:
      a. Unless specified otherwise, conform to PCI MNL-116.
      b. U-lintel units 14 feet in overall length and shorter shall be made of concrete with a minimum strength of 3500 psi at 28 days.
      c. U-lintel units exceeding 14 feet in overall length shall be made of concrete with a minimum strength of 6000 psi at 28 days and shall be prestressed concrete.
      d. Units shall be sand block finish except prestressed, 6 inch wide, and 12 inch wide U-lintels shall be smooth form finished.
      e. Tolerances shall be per PCI MNL-116
      f. Minor patching in plant is acceptable provided structural adequacy of units is not impaired

   4. Acceptable Product/Manufacturer: Cast-Crete High Strength Precast Concrete U-lintels as manufactured by Cast-Crete, Tampa, FL (800) 999-4641, and locally distributed by Headwaters, (713) 365-9077.

G. Block Insulation:
   1. Rigid Core Inserts:
      a. Type: “U” shaped insulation inserts conforming to ASTM C578, replacing Federal Specification (FS) HH-I-524C, Type I, specification for Preformed Cellular Polystyrene Thermal Insulation.
      b. Sizes: As required for 6 inch, 8 inch, 10 inch, and 12 inch blocks as shown or required.

c. Approved Product/Manufacturer: Korfil Insulation Inserts manufactured by Concrete Block Insulating Systems (CBIS), West Brookfield, MA; (800) 628-8476, or Architect approved equivalent.

2. Loose Core Fill: Loose perlite or vermiculite insulation conforming to ASTM C332, Standard Specification for Lightweight Aggregates for Lightweight Concrete, such as Zonolite manufactured by Siplast, Irving, TX; (800) 922-8800, or Architect approved equivalent. Loose fill insulation shall be certified asbestos-free.
4. Sand Fill: Clean, dry sand of type recommended to suit application.

H. Miscellaneous Materials: (As shown or required)
1. Reinforcing Steel: ASTM A615, Grade 60.
2. Forms: Form grade plywood with wood studs and wales as required.
3. Shores: Patented shores of design and manufacture sufficient to safely support imposed loads.
4. Premolded Filler: Fibrous mastic strips containing 35 percent to 50 percent asphaltic impregnation, ASTM D1751.
5. Flashing Cement: "Nerva-plast" cold setting mastic manufactured by Nervastral, Inc., or Architect approved equal.
6. Building Felt: No. 15 asphalt saturated felt, ASTM D226.
7. Dovetail Anchors: 16 gauge galvanized dovetail corrugated masonry anchor, 1 inch x 3-1/2 inch manufactured by Heckman Building Products, Inc., Hohmann & Barnard, Inc., Masonry Reinforcing Corporation of America, or Architect approved equal.
8. Steel Shapes and Plates: As shown on drawings and specified in Section 05 50 00, Metal Fabrications.
9. Headed Stud Anchor: Welded by full-fusion process as furnished by TRW Nelson Stud Welding Division, or Architect approved equal.
10. Bolts: ASTM A307. Furnish with carbon steel washers.
11. Deformed Bar Anchors: Welded by full-fusion process as furnished by TRW Nelson Stud Welding Division, or Architect approved equal.
12. Reinforcing Bars to be Welded: ASTM A706.
13. Cavity Drainage Protection: 2 inch thick by 10 inch high by 5 feet long recycled polyester/ polyethylene mesh, trapezoidal-shaped, continuous at foundation, at heads above openings, and shelf angles as indicated on drawings. Provide Mortar Net™ manufactured by Mortar Net Solutions, Burns Harbor, IN; (800) 664-6638, or Architect approved equal.
14. Masonry Color: Iron oxide pigment conforming to ASTM C979 in color(s) selected by Architect, shall be inert, stable to atmospheric conditions, sunfast, weather resistant, alkali resistant, water insoluble, and free of fillers and extenders, as manufactured by ChemSystems, Inc., Davis Colors, Solomon Grind-Chem Service, Inc., or Architect approved equal.
15. Weep Hole Vents: Injection molded vent made from flexible polyvinyl chloride in an offset "T" shape, inserted in head joints, the slotted leg of the vent allows air to pass in and out allows water to weep out and prevents water from penetrating in manufactured by Williams-Goodco, Phone: 800-521-9594 or 248-643-6400 or Email: Wilpro@williamsproducts.net. Weep hole vents shall be sized to match masonry (may require custom sizing).

2.3 MASONRY STRENGTH

A. Ultimate compressive strength of masonry as required by design and determined by prism tests shall not be less than 1,800 psi, unless stated otherwise in Structural Drawings.

2.4 MASONRY CLEANING MATERIALS

A. Detergent Cleaner: Bucket and brush hand cleaning method, BIA Technical Notes 20.

B. Proprietary Acidic Cleaner: Cleaner designed for removing mortar/grout stains, efflorescence, and construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Diedrich Technologies, Inc.
      b. PROSOCO, Inc.
      c. AHI Supply.

C. The following products based on AHI Supply TexClean products are intended as a guide only and does not preclude the contractors use of equal products by listed manufacturers. Consult manufacturer prior to application for any questions or inconsistencies.

Substrate	Color/Type	Cleaning Solution
Brick	Red	Tex Clean Masonry Cleaner
	Light	Tex Tral Masonry Cleaner
	Dark	Tex Tral Masonry Cleaner
	Pavers	Tex Clean Masonry Cleaner
	Glazed	Tex Tral Masonry Cleaner
CMU	Split Face	Tex Tral Masonry Cleaner
	Burnished/Ground Face	Tex Tral Masonry Cleaner
Architectural Concrete	Natural Color/Smooth	Tex Tral Masonry Cleaner
	Textured	Tex Clean Masonry Cleaner
Stone Construction	Cast Stone	Tex Tral Masonry Cleaner
	Arriscraft	Tex Tral Masonry Cleaner
	Limestone (Unpolished)	Tex Tral Masonry Cleaner

PART 3 - EXECUTION

3.1 FORMS AND SHORES

A. Provide forms and shores sufficiently strong and rigid as required to support soffits, beams, and lintels during construction.

B. Build forms to conform to shape, line, and dimension of masonry members as detailed, substantial and sufficiently tight to prevent leakage of mortar, grout or concrete. Properly brace or tie together so as to maintain position and shape.

3.2 PREPARATION OF MATERIALS

A. Concrete Masonry Units:
   1. Where cutting is required, masonry shall be cut with a sharp masonry saw.
   2. Ensure concrete masonry units to receive sand fill are ready for filling and cutouts are protected from material spillage.

B. Brickwork: Dampen brick before laying in a manner consistent with the nature of the brick, the mortar, and the weather conditions.

C. Mortar and Grout:
   1. Use suitable containers for material measurement. Measuring sand by the shovel is not acceptable.
   2. Thoroughly machine mix a minimum of five (5) minutes after all materials are in mixer.
   3. Consistency will completely fill all spaces intended to receive grout.
   4. Use within 2-1/2 hours of initial mixing.
   5. Mortar or grout shall not be used if curing has progressed to yield a stiff consistency.

D. Reinforcement:
   1. Reinforcement shall be free from loose rust and other coatings that would reduce the bond.
   2. Cut accurately to length and bend by such methods as will prevent injury to the material.
   3. Straighten out kinks or bends.

E. Flashing:
   1. Locations: Install in exterior walls to divert moisture within walls to exterior surfaces.
   2. Bed Joints: Coordinate work with Division 4, Masonry. Install flashings between two (2) thin layers of masonry mortar without increasing thickness of mortar joint. Keep outer edge of flashing material back from face of masonry.
   3. Adjacent Work: Protect work by masking, covering, or other precautionary methods. Remove protection when no longer necessary.
   4. Separate copper flashing from dissimilar materials.
   5. Protect membrane flashing from overexposure to direct sunlight.

3.3 INSTALLATION

A. General:
   1. Do not use chipped or cracked concrete masonry units (CMU) and face brick, where exposed to view.
   2. Use masonry saws to cut and fit exposed units.
   3. Exposed masonry at exterior corners shall be solid units.
   4. Clean surface of masonry smooth and free from projections which might puncture or otherwise damage flashing material.
   5. Place through-wall flashing as follows:
      a. Place on bed of mortar and cover with mortar.
      b. Provide at steel columns and beams in exterior masonry walls and elsewhere as indicated on the drawings or required.
      c. Install asphalt laminated copper membrane as base flashing at all exterior cavity walls below weep holes.
      d. Install at material transitions inside exterior cavity walls, roof edge/exterior wall transitions, masonry joints (control/expansion) inside exterior cavity walls, exterior wall sill/weep conditions, exterior door and window frame perimeters, roof deck/exterior wall transitions, exterior wall penetrations (i.e. pipe, conduit, ducts, etc.). Provide membrane at all joints, holes, gaps or openings to ensure a continuously sealed building envelope.

6. Lay masonry units plumb, true to line, and with level courses accurately spaced within allowable tolerances.
7. Do not furrow bed joints.
8. Stop off horizontal run by racking back in each course; toothing is not permitted.
9. Adjust units to final position while mortar is soft and plastic.
10. If units are displaced after mortar has stiffened, remove, clean joints and units and re-lay with fresh motor.

11. When joining fresh masonry to set or partially set masonry:
    a. Remove loose masonry units and mortar
    b. Clean and lightly wet exposed surface of set masonry prior to laying fresh mortar.

B. Metal Door Frames: Fill jamb frames solid with mortar. Build in anchors.

C. Lintels and Bond Beams: Provide reinforced unit type, except where steel lintels are shown. Use reinforcing bars as shown on the drawings. Completely fill in lintel block and bond beams with grout. Provide 8 inch bearing at end of lintels.

D. Corners: Connect corners with No. 9 galvanized wire tie using one tie for each 4 inches of nominal wall thickness.

E. Partition Tops: Allow space at top of horizontal spanning walls for compressible joint back-up and sealant as specified in Sealant section. Anchor top of walls to deck or structure.

F. Mortar Beds:
1. Place mortar in a manner which will result in the development of adequate bond between the masonry and the reinforcement.
2. Lay units with full mortar coverage on horizontal and vertical joints in all courses.
3. Provide sufficient mortar on ends of masonry unit to fill head joints.
4. Rock closures into place with head joints thrown against two adjacent masonry units in place.
5. Do not pound corners or jambs to fit stretcher units after setting in place.
6. Where adjustment to corners or jambs must be made after mortar has started to set, remove mortar and replace with fresh mortar.

G. Mortar Joints and Patterns:
1. Lay CMU in running one-half (1/2) bond pattern, unless noted otherwise.
2. Lay brick in running one-third (1/3) bond pattern, unless noted otherwise on drawings. Refer to drawings for accent coursing.
3. Provide flush joints where concealed from view and where dampproofing is scheduled.
4. Provide standard concave tooled joint where masonry is exposed to view for brick and CMU, typically.
5. All mortar joints to be of consistent size.
6. Provide soldier courses where indicated, refer to the elevations.
7. All horizontal joints shall be concave tooled joint at face of units, unless noted otherwise.
8. Provide raked joints at all exposed burnished cmu locations.

H. Reinforcement, Anchor and Tie Systems:
1. General:
    a. Completely embedded in mortar or grout.
    b. All reinforcement consisting of bars or wire 1/4 inch or less in diameter embedded in the horizontal mortar joints shall have no less than 5/8 inch mortar coverage from the exposed face.
    c. Where modular brick is used with brick coursing at 16 inches on center, provide ladder reinforcing within each wythe at 16 inches o.c. vertically for exterior wythe

and back-up wythe, whether detailed or not. For other than modular brick, refer to Paragraph h. below.

d. Veneer anchors at exterior sheathed covered metal stud exterior walls shall be attached on outside face of sheathing using cadmium plated sheet metal screws. Spacing shall be same as stud spacing o.c. horizontally and 16 inches o.c. vertically.

e. At intersection of all perpendicular masonry walls provide two (2) vertical rows of ladder type reinforcing at 16 inches o.c. vertically.

f. Weld veneer anchors to structural steel in accordance with manufacturer's recommendations. Touch-up steel shop paint and galvanized coating on anchor with touch-up primer and finish coats to match damaged coating in accordance with manufacturer's recommendations.

g. In cavity walls with CMU back-up, embed truss type horizontal reinforcement with integral adjustable pintle wall ties every 16 inches o.c. vertically.

h. Splices in reinforcement: Splices may be made only at such points and in such manner that the structural strength of the member will not be reduced. Lapped splices shall be eight (8) inches. Welded or mechanical connection shall develop the strength of the reinforcement.

i. Corrugated strap ties shall not be used as veneer anchors at exterior or where subject to moisture. Their use in interior, dry conditions are acceptable.

j. Place joint reinforcement in the first two (2) bed joints above and the first two (2) bed joints below masonry openings. Extend extra reinforcing two (2) feet beyond jambs.

k. Provide masonry ties at floor and roof decks as indicated.

I. Flashing:

1. Follow manufacturer's instructions for mechanically fastened installation with a termination bar.

2. Application Guidelines - Install flashing at the following locations:

   a. Membrane Flashing: material transitions inside exterior cavity walls, roof edge/exterior wall transitions, masonry joints (control/expansion) inside exterior cavity walls, exterior door and window frame perimeters, roof deck/exterior wall transitions, exterior wall penetrations (i.e. pipe, conduit, ducts, etc.). Provide membrane at all joints, holes, gaps, or openings to ensure a continuously sealed building envelope. Utilize primer on substrates as instructed by manufacturer.

   b. Copper Flashing: At all horizontal wall flashing, including (but not limited to) exterior wall sill/weep conditions, exterior door and window head/weep conditions, masonry wall cap flashing and masonry wall base flashing.

3. Apply substrate primer as instructed by membrane manufacturer to suit condition.

4. Provide drip edge flashing at weep conditions with membrane flashing. Cut membrane flush with outside edge of brick over top of drip edge flashing to alleviate exposure to UV degradation and deterioration of asphalt membrane.

5. On Horizontal Surfaces: The flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches. Flashing will then be secured in back wall with termination bar.

6. On Vertical Surfaces: Surfaces receiving the flashing shall be sufficiently spotted with asphalt mastic to hold in place until masonry is set. Secure in back wall with termination bar.

7. Foundation Sill Dampproofing: The flashing for foundation sills shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be sloped across the cavity and turned up the wall a minimum of ten (10)

inches and secured to back wall with termination bar. Where sill and column meet, flashing shall be brought up a minimum of ten (10) inches up the column.

8. Thru-Wall Flashing: Shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Carry flashing through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secure in back wall with termination bar.
9. Cavity Wall: Flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secured in the back wall with termination bar. Vertical membrane joints shall be secured with termination bar as instructed by membrane manufacturer.
10. Heads and Sills: Flashing for heads and sills shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise. Head flashing shall be carried six (6) inches beyond both end of the steel lintel. Both head and sill flashing shall be turned up at the sides to form a pan. All corners shall be folded, NOT CUT. Install weepholes.
11. Spandrels: Spandrel flashing shall start from the outside toe of the shelf angle, go up the face of the beam and then through the wall, turned up on the inside not less than two (2) inches. Install weepholes.
12. Parapet or Coping: Flashing for parapets or coping sills shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Weepholes shall be installed immediately on top of the flashing.
13. Lengths: Install flashings without longitudinal joints within walls, if possible. If required materials are not available in a single width, join by lapping material minimum two (2) inches and seal joint throughout its length with adhesive.
14. End Joints: Avoid end joints in flashing. When end joints are necessary, lap flashing minimum six (6) inches and seal joint continuously with adhesive.
15. Penetrations: Where anchors, pipes, and inserts penetrate flashing, make opening in flashing snug and seal with adhesive.
16. Reglet Termination: Insert wedge into place and seal carefully with adhesive
17. Termination Bar: Install flashing with termination bars in accordance with manufacturer's instructions. Provide 3 coursing at all termination bars, typical.
18. Top Coat: After flashing material is in place (except in masonry joints where bond and mortar is required) trowel full 1/8 inch protective coating or mastic on all flashing faces.

J. Laying Masonry: Lay units plumb, level, and true to line with full head and bed joints. Butter ends of masonry with sufficient mortar to fill head joints. Do not furrow bed joints. Slope top of bed joint toward center of wall to minimize amount of mortar forced into grout space. Remove mortar, protruding from joints into grout space, before pouring grout.

K. Reinforcing Bars:
1. Hold vertical bars in position at top and bottom and at intervals not exceeding eight 8 feet-0 inches with a minimum clearance of 1/4 inch from masonry and not less than one (1) bar diameter between bars.
2. When a foundation dowel is not in alignment with a vertical block cell or pilaster, slope it not more than one (1) horizontal in six (6) vertical to bring it into proper alignment before grouting.
3. Place horizontal reinforcing bars in continuous masonry courses, consisting of bond-beam or trough block units, and solidly grout in place.
4. Use straight reinforcing bars except for bends around corners and where bends or hooks are detailed on plans.
5. Lap reinforcing steel 40 bar diameters minimum where spliced and wire together.

L. Grouting: Where detailed place grout in reinforced masonry beams, walls, columns, and pilasters. All cells and spaces containing reinforcing bars shall be filled with grout. Wherever possible grouting shall be done from inside face of masonry. Exercise extreme care to prevent grout from staining face of masonry. Immediately remove any spilled grout from face and top of masonry.

1. Prior to grouting clean space so that all spaces to be filled with grout do not contain mortar projections greater than 1/2 inch, mortar droppings or other foreign material. Grout shall be placed so all spaces designated to be grouted shall be filled with grout and grout shall be confined to those specific spaces.
2. Grout materials and water content shall be controlled to provide adequate fluidity for placement, without segregation of constituents and shall be mixed thoroughly.
3. Between grout pours a horizontal construction joint shall be formed by stopping all wythes at the same elevation and with grout stopping a minimum of 1-1/2 inches below a mortar joint, except at top of wall. Where bond beams occur, stop grout pour a minimum of 1/2 inch below top of masonry.
4. Reinforcement shall be placed prior to grouting. Bolts shall be accurately set with templates or by approved equivalent means and held in place to prevent movement.
5. Segregation of grout materials and damage to masonry shall be avoided during the grouting process. Adequately brace masonry to prevent displacement or cracking during grouting operations.
6. Grout shall be consolidated by mechanical vibrator during placing, before loss of plasticity, in a manner to fill grout space. Grout pours greater than 12 inches shall be reconsolidated by mechanical vibration to minimize voids due to water loss. Grout pours 12 inches or less in height shall be mechanically vibrated, or puddled.
7. Grout shall not be handled nor pumped utilizing aluminum equipment.
8. Size and height limitations of grout space or cell shall be as follows:

GROUT TYPE	GROUT POUR MAX. HEIGHT (FEET)	LEAST CLEAR DIMENSIONS		CLEANOUTS REQUIRED
		Width of Grout Space (In.)	CMU Cell Dim. Dims. (In. x In.)	
Fine	1	3/4	1-1/2 x 2	No
Fine	5	1-1/2	1-1/2 x 2	No
Fine	8	1-1/2	1-1/2 x 3	Yes
Coarse	1	1-1/2	1-1/2 x 3	No
Coarse	5	2	2-1/2 x 3	No
Coarse	8	2	3 x 3	Yes

   a. Clear dimension is the cell or grout space width less mortar projections.
   b. Grout space width shall be increased by the horizontal projection of the diameters of horizontal bars within the cross section of the grout space.

9. Place grout in lifts not exceeding 8 feet-0 inches.

M. Concreting: Supervise placing of concrete in cores of masonry beams and lintels and over masonry soffits where structural concrete is detailed. Report discrepancies or procedures which may adversely affect performance of masonry work.

N. Brick Weep holes:

1. Provide weep holes above all thru-wall flashings where weep holes occur at the base of the wall. The mason shall coordinate the location of the thru-wall flashings with the location of the sidewalks on the civil engineering drawings. All weep holes shall be at

least one course below finished floor or at the first course of brick above the sidewalks. Pay particular attention to areas near exterior doors.

2. Ensure cavity drainage protection is properly installed.
3. Leave head joint free and clean of mortar.
4. Spacing: 20 inches on center maximum for king sized brick, and 24 inches on center for modular brick and block, unless shown otherwise.
5. Keep weep holes and area above flashing free of mortar droppings.
6. Coordinate weep holes to be located above sidewalks and paving.

O. Sealant Joints:
   1. Allow for sealant joints around outside perimeters of exterior doors, window frames and other wall openings.
   2. Uniform depth: 3/4 inch.
   3. Uniform width: As shown on the drawings but not less than 1/4 inch.
   4. Provide sample for Architect's approval.
   5. Refers to drawing for locations and details of accent joints.

P. Movement Joints (Expansion Joints and Control Joints):
   1. Locate expansion and control joints as shown on drawings, or if not shown, comply with the following:
      a. General:
         1) Vertical expansion joints shall be placed in the brick wythe and control joints shall be placed in the concrete masonry wythe, although they do not necessarily have to be aligned.
         2) Mortar and joint reinforcement shall not bridge brick movement joints.
         3) Mortar joints which stop at the expansion joint cavity shall be struck flush with the masonry unit, producing a continuous flat surface for the sealant to adhere to.

      b. Vertical Expansion Joints:
         1) Locate expansion joints on long straight walls without openings maximum 25 feet-0 inches.
         2) Locate expansion joints at the corner of walls perpendicular to one another. In instances, where the joint is not desired at the corner, the expansion joint shall be located within 10 feet-0 inches of the corner in either wall, but not necessarily both. The spacing of expansion joints around a corner shall not exceed the spacing of expansion joints in a straight wall. For example, if the spacing between expansion joints on a straight wall is 25 feet-0 inches, then the spacing of expansion joints around a corner could be 10 feet-0 inches on one side of the corner and 15 feet-0 inches on the other side. Joint reinforcement may be added around wall corners to provide added tensile strength to the corner, but joint reinforcement shall not bridge the expansion joint.

      c. Offsets and Setbacks:
         1) Locate expansion joints at 10 feet-0 inches maximum on one side of the offset or setback. The spacing of expansion joints around an offset or setback shall not exceed the spacing of expansion joints in a straight wall. See expansion joints at corners of perpendicular walls to one another above for example of spacing.

      d. Openings (Doors and Windows):
         1) Locate vertical expansion joints along the edge or jamb of the opening of windows and doors. Single opening windows and doors under 6 feet-0

inches in width shall have expansion joint on one (1) side of the edge or jamb of the opening as determined by the Architect, unless shown otherwise on drawings. Windows and doors 6 feet-0 inches and over in width shall have expansion joints on both sides of the edge or jamb of the opening.

2) Where masonry above an opening is supported by shelf angles attached to the structure, a vertical expansion joint shall be located alongside the opening, continuing through the horizontal support.

3) Where masonry above the opening is supported by loose lintels (unattached to the structure), special detailing and construction is required. If the expansion joint runs along side the opening, the loose steel lintel shall be allowed to expand independently of the masonry. To accomplish this, form a slip plane with flashing located above and below the angle. A backer rod and sealant shall be installed in front of the toe of the angle, and space shall be left at the end of the angle. Thus, a pocket will be formed which will allow movement of the steel angle within the brickwork. If the joint cannot be built in this manner, then the vertical expansion joint shall not be located alongside the opening, but rather, with Architect's prior approval, the joint shall be located halfway between the openings.

e. Intersections and Junctions:

1) Locate expansion joints at intersections of masonry walls and walls which serve different functions. If the masonry is not required to be bonded at the intersection, an expansion joint shall be incorporated. Walls which intersect at other than right angles are also vulnerable to cracking at the intersection.

2) Locate expansion joint to separate adjacent walls of different heights to avoid differential movement, especially if the difference is very large.

f. Parapets:

1) All vertical expansion joints shall be carried through the parapets.

2) Additional expansion joints shall be halfway between those running full height, unless the parapet is reinforced. These additional expansion joints shall continue down to a horizontal expansion joint, or continue to the base of the wall.

g. Horizontal Expansion Joints:

1) Locate horizontal expansion joints at shelf angles supporting brick masonry.

h. Control Joints:

1) Locate CMU control joints directly over concrete slab control joints.

2) Whenever possible, lay out CMU so that control joint will coincide with CMU module (25 feet-0 inch maximum spacing between control joints), unless noted otherwise on drawings.

3) Locate control joints at structural columns to isolate movement from continuing or intersecting walls and columns.

4) Install backer rod and sealant in accordance with manufacturer's instructions.

3.4 ALLOWABLE TOLERANCES

A. Maximum Variation from Plumb:

1. In lines and surfaces of columns, walls and at rises:

a. 1/4 inch in 10 feet (1:480).

b. 3/8 inch in 20 feet (maximum).

c. 1/2 inch in 40 feet (1:960).

2. For external corners, expansion joints and other conspicuous lines:
   a. 1/4 inch in 20 feet (maximum).
   b. 1/2 inch in 40 feet (1:960).

B. Maximum variation from level:
   1. 1/4 inch in any bay or 20 feet.
   2. 1/2 inch in 40 feet (1:960).

3.5 REMOVAL OF FORMS AD SHORES

A. Do not remove shores and forms under reinforced masonry beams, lintels, and soffits until members have hardened sufficiently to carry their own weight and other super imposed loads. Providing that sufficient curing has taken place, leave forms and shores in place as follows:
   1. Beam and lintels: Minimum ten (10) days.

B. Allow 16 hours to elapse after completion of masonry columns and walls before placing floor or roof construction loads on them. Allow an additional 48 hours before applying concentrated loads such as trusses, girders, and beams.

3.6 REPAIRING, POINTING AND CLEANING

A. All holes in exposed masonry shall be pointed, and defective joints shall be cut out and re-pointed with mortar.

B. Before applying any cleaning agent to the entire wall, it shall be applied to a sample wall area of approximately 20 square feet, in a location approved by Architect. No further cleaning work may proceed until the sample area has been approved by Architect, after which, the same cleaning materials and method shall be used on remaining wall area. Sash, metal lintels and other corrodible parts shall be thoroughly protected.
   Clean all exposed surfaces of new masonry of excess mortar, efflorescence, stains, and job dirt, using materials specified.
   1. Clean from bottom up; prevent cleaning materials and rinse water from contacting non-cementitious materials.
   2. Clean in accordance with manufacturer's instructions and recommendations, product data, and container label instructions.
   3. Mix materials in strict accordance with manufacturers instructions; do not dilute unless permitted by manufacturer.
   4. Prevent overspray, wind drift, and splash onto surfaces not to be treated.
   5. No high pressure washers are permitted.
   6. Low pressure spray for wetting and rinsing is permitted. Pressure should be in the range of 400-1000 psi. Equipment should produce 6-8 gallons of water per minute using a 15-40 degree fan tip (no fan tip less than a 15 degree is allowed).
   7. No metal tools or wire brushes are allowed for cleaning of masonry. Use a waste piece of same masonry material for scraping of installed material.

3.7 REPAIR OR REPLACEMENT OF DAMAGED WORK

A. Imperfect or damaged work, or any material damaged or determined to be defective before final completion and acceptance of the entire job, shall be satisfactorily replaced at Contractor's expense and in conformity with all requirements of drawings and specifications. Removal and replacement of masonry work shall be performed in such a manner as not to impair the appearance or strength of the structure in any way.

3.8 CLEAN-UP AND PROTECTION

A. Clean up all debris caused by work of this Section, keeping the area clean and neat at all times.

B. Cover all unfinished work at night against the elements with plastic sheeting, building paper, heavy canvas or other material approved by Architect to prevent water from entering cavities.

C. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure unit masonry is without damage and deterioration at time of Substantial Completion.

3.9 FIELD QUALITY CONTROL AND TESTING

A. Inspection and Testing Laboratory services shall be in accordance with Section 01 45 23, Testing and Inspecting Services.

END OF SECTION 04 20 00

SECTION 04 20 16

REINFORCED UNIT MASONRY ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes concrete masonry units, reinforcement, anchorage, and accessories.

B. Related Sections:
1. Section 040514 - Masonry Mortar and Grout: Mortar and grout.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 530 - Building Code Requirements for Masonry Structures.
2. ACI 530.1 - Specifications for Masonry Structures.

B. ASTM International:
1. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
2. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
4. ASTM A580/A580M - Standard Specification for Stainless Steel Wire.
5. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
6. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
7. ASTM A951 - Standard Specification for Masonry Joint Reinforcement.
8. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction.
9. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
10. ASTM C27 - Standard Classification of Fireclay and High-Alumina Refractory Brick.
11. ASTM C34 - Standard Specification for Structural Clay Load-Bearing Wall Tile.
12. ASTM C55 - Standard Specification for Concrete Brick.
13. ASTM C56 - Standard Specification for Structural Clay Non-Load-Bearing Tile.
14. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale).
15. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
16. ASTM C73 - Standard Specification for Calcium Silicate Face Brick (Sand-Lime Brick).
17. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
18. ASTM C126 - Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units.

19. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units.
20. ASTM C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units.
21. ASTM C212 - Standard Specification for Structural Clay Facing Tile.
22. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
23. ASTM C315 - Standard Specification for Clay Flue Linings.
24. ASTM C530 - Standard Specification for Structural Clay Non-Loadbearing Screen Tile.
25. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
26. ASTM C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale).
27. ASTM C744 - Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
28. ASTM C1261 - Standard Specification for Firebox Brick for Residential Fireplaces.
29. ASTM C1283 - Standard Practice for Installing Clay Flue Lining.
30. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
31. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
32. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

C. National Fire Protection Association:
   1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

D. Underwriters Laboratories Inc.:
   1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.3 PERFORMANCE REQUIREMENTS

A. Concrete Masonry Compressive Strength
   1. Concrete Masonry Units: 1900 psi minimum net area compressive strength.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Submittal requirements.

B. Shop Drawings: Indicate bars sizes, spacings, locations, reinforcement quantities, bending and cutting schedules, supporting and spacing devices for reinforcement.

C. Product Data:
   1. Submit data for masonry units and fabricated wire reinforcement.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 530 and ACI 530.1.

1.6 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Section 016000 - Product Requirements.

B. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F.

C. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

PART 2 PRODUCTS

2.1 COMPONENTS

A. Hollow Load Bearing Concrete Masonry Units (CMU): ASTM C90; normal weight.

2.2 ACCESSORIES

A. Single Wythe Joint Reinforcement: ASTM A951; ladder type; 0.148 inch diameter side rods with 0.148 inch diameter cross ties.

B. Reinforcing Steel: ASTM A615/A615M, 60 ksi yield grade, deformed billet bars.

C. Anchor Rods: ASTM A307; Grade C; J-shaped or L-shaped; complete with washers and heavy hex nuts; sized for minimum 15 inch embedment.
   1. Hot-Dipped Galvanizing: ASTM A153/A153M.
   2. Mechanical Galvanizing: ASTM B695; Class 55.

D. Mortar and Grout: As specified in Section 04065.

E. Joint Filler: Closed cell rubber; oversized 50 percent to joint width; self expanding.

2.3 SOURCE QUALITY CONTROL

A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.

B. Test brick efflorescence in accordance with ASTM C67. Brick rated greater than “slightly effloresced” is not acceptable.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 013000 - Administrative Requirements: Coordination and project conditions.

B. Verify field conditions are acceptable and are ready to receive work.

C. Verify items provided by other sections of work are properly sized and located.

D. Verify built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

A. Direct and coordinate placement of metal anchors supplied to other Sections.

B. Furnish temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent support.

C. Wet clay and shale brick before laying when initial rate of absorption is greater than 30 grams when tested in accordance with ASTM C67.

3.3 INSTALLATION

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form bed and head joints of uniform thickness.

C. Coursing of Concrete Masonry Units:
1. Bond: Running.
2. Coursing: One unit and one mortar joint to equal 8 inches.
3. Mortar Joints: Concave.

D. Placing And Bonding:
1. Lay solid masonry units in full bed of mortar, with full head joints.
2. Lay hollow masonry units with face shell bedding on head and bed joints.
3. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
4. Remove excess mortar as Work progresses.
5. Interlock intersections and external corners.
6. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment is required, remove mortar and replace.
7. Perform job site cutting of masonry units with proper tools to assure straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
8. Isolate masonry from vertical structural framing members with movement joint .
9. Isolate top of masonry from horizontal structural framing members and slabs or decks.

E. Joint Reinforcement And Anchorage:
1. Install horizontal joint reinforcement 16 inches oc.
2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
3. Place joint reinforcement continuous in first and second joint below top of walls.
4. Lap joint reinforcement ends minimum 6 inches.
5. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

6. Embed anchors embedded in concrete attached to structural steel members. Embed anchorages in every sixth brick.

F. Lintels:
1. Install precast concrete lintels over openings.
2. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled or indicated.
3. Openings Up To 42 inches Wide: Reinforce openings as indicated on Drawings.
4. Openings From 42 inches Up To 78 inches Wide: Reinforce openings as indicated on Drawings.
5. Openings Over 78 inches: Reinforce openings as indicated on Drawings.
6. Do not splice reinforcing bars.
7. Support and secure reinforcing bars from displacement.
8. Place and consolidate grout fill without displacing reinforcing.
9. Allow masonry lintels to attain specified strength before removing temporary supports.
10. Maintain minimum 8 inches bearing on each side of opening.

G. Grouted Components:
1. Reinforce bond beam with 1, No. 5 bar.
2. Reinforce pilaster with 1, No. 6 bar in each cell.
3. Lap splices bar diameters required by code.
4. Support and secure reinforcing bars from displacement.
5. Place and consolidate grout fill without displacing reinforcing.
6. At bearing locations, fill masonry cores with grout for minimum 12 inches either side of opening.

H. Reinforced Masonry:
1. Lay masonry units with cells vertically aligned and cavities between wythes clear of mortar and unobstructed.
2. Place reinforcing, reinforcement bars, and grout as indicated on Drawings.
3. Splice reinforcement in accordance with Section 03200.
4. Support and secure reinforcement from displacement.
5. Place and consolidate grout fill without displacing reinforcing.
6. Place grout in accordance with ACI 530.1 Specification for Masonry Structures.

I. Control And Expansion Joints:
1. Install control and expansion joints at the following maximum spacings, unless otherwise indicated on Drawings:
   a. Exterior Walls: 20 feet on center and within 10 feet on one side of each interior and exterior corner.
   b. Interior Walls: 30 feet on center.
   c. At changes in wall height.
2. Do not continue horizontal joint reinforcement through control and expansion joints.
3. Install preformed control joint device in continuous lengths. Seal butt and corner joints.
4. Size control joint in accordance with Section 07900 for sealant performance.
5. Form expansion joint by omitting mortar and cutting unit to form open space.

J. Cutting And Fitting:

1. Obtain Architect/Engineer's approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.4 ERECTION TOLERANCES

A. Section 014000 - Quality Requirements: Tolerances.

B. Maximum Variation From Alignment of Pilasters: 1/4 inch.

C. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.

D. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

E. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

F. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

G. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.

H. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

I. Maximum Variation for Steel Reinforcement:
1. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.
2. Plus or minus 1/2 inch when distance from centerline of steel to opposite face of masonry is 8 inches or less.
3. Plus or minus 1 inch when distance is between 8 and 24 inches.
4. Plus or minus 1-1/4 inch when distance is greater than 24 inches.
5. Plus or minus 2 inches from location along face of wall.

3.5 FIELD QUALITY CONTROL

A. Concrete Masonry Units: Test each type in accordance with ASTM C140.

3.6 CLEANING

A. Section 017000 - Execution Requirements: Final cleaning.

B. Remove excess mortar and mortar smears as work progresses.

C. Replace defective mortar. Match adjacent work.

D. Clean soiled surfaces with cleaning solution.

E. Use non-metallic tools in cleaning operations.

3.7 PROTECTION OF FINISHED WORK

A. Section 017000 - Execution Requirements: Requirements for protecting finished Work.

B. Protect exposed external corners subject to damage.

C. Protect base of walls from mud and mortar splatter.

D. Protect masonry and other items built into masonry walls from mortar droppings and staining caused by mortar.

E. Protect tops of masonry work with waterproof coverings secured in place without damaging masonry. Provide coverings where masonry is exposed to weather when work is not in progress.

END OF SECTION

SECTION 05 12 00

STRUCTURAL STEEL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Structural shapes.
2. Channels and angles.
3. Hollow structural sections.
4. Structural pipe.
5. Structural plates and bars.
6. Fasteners, connectors, and anchors.
7. Fasteners, connectors, and anchors.
8. Grout.

B. Related Sections:
1. Section 036000 - Grout: Grout for setting base plates.
2. Section 052100 - Steel Joists.
3. Section 053123 - Steel Roof Deck
4. Section 055000 – Metal Fabrications: Steel Fabrications affecting structural steel work.

1.2 REFERENCES

A. American Institute of Steel Construction:
1. AISC Code of Standard Practice for Steel Buildings and Bridges.
2. AISC Load and Resistance Factor Design (LRFD) Specification for Structural Steel Buildings.
3. AISC Load and Resistance Factor Design Specification for Single-Angle Members.
4. AISC Seismic Provisions for Structural Steel Buildings.
5. AISC Specification for Allowable Stress Design of Single-Angle Members.
6. AISC Specification for the Design of Steel Hollow Structural Sections.
7. AISC Specification for Structural Steel Buildings Allowable Stress Design, and Plastic Design.

B. ASTM International:
1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
4. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
5. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
6. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.

7. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
8. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
9. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
10. ASTM A449 - Standard Specification for Quenched and Tempered Steel Bolts and Studs.
11. ASTM A490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
12. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
13. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
14. ASTM A514/A514M - Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding.
15. ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality.
16. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
17. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
18. ASTM A588/A588M - Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4-in. (100-mm) Thick.
19. ASTM A618 - Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing.
20. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
21. ASTM A847 - Standard Specification for Cold-Formed Welded and Seamless High Strength, Low Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance.
22. ASTM A852/A852M - Standard Specification for Quenched and Tempered Low-Alloy Structural Steel Plate with 70 ksi (485 MPa) Minimum Yield Strength to 4 in. (100 mm) Thick.
23. ASTM A913/A913M - Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST).
24. ASTM A992/A992M - Standard Specification for Structural Steel Shapes.
25. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
26. ASTM E94 - Standard Guide for Radiographic Examination.
27. ASTM E164 - Standard Practice for Ultrasonic Contact Examination of Weldments.
28. ASTM E165 - Standard Test Method for Liquid Penetrant Examination.
29. ASTM E709 - Standard Guide for Magnetic Particle Examination.
30. ASTM F436 - Standard Specification for Hardened Steel Washers.
31. ASTM F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
32. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
33. ASTM F1852 - Standard Specification for Twist Off Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

C. American Welding Society:
   1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
   2. AWS D1.1 - Structural Welding Code - Steel.

D. Research Council on Structural Connections:
   1. RCSC - Specification for Structural Joints Using ASTM A325 or A490 Bolts.

E. SSPC: The Society for Protective Coatings:
   1. SSPC - Steel Structures Painting Manual.
   2. SSPC Paint 15 - Steel Joist Shop Paint.
   3. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).
   4. SSPC SP 3 - Power Tool Cleaning.
   5. SSPC SP 6 - Commercial Blast Cleaning.
   6. SSPC SP 10 - Near-White Blast Cleaning.

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings:
   1. Indicate profiles, sizes, spacing, and locations of structural members, openings, attachments, and fasteners.
   2. Connections.
   3. Cambers
   4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.

C. Mill Test Reports: Submit indicating structural strength and destructive and non-destructive test analysis.

D. Manufacturer’s Mill Certificate: Certify products meet or exceed specified requirements.

E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualifications within previous 12 months.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with the following:
   1. AISC Code of Standard Practice for Steel Buildings and Bridges.
   2. AISC Code of Standard Practice for Steel Buildings and Bridges. Section 10.
   3. AISC Seismic Provisions for Structural Steel Buildings.
   4. AISC Specification for Structural Steel Buildings Allowable Stress Design, and Plastic Design.
   5. AISC Load and Resistance Factor Design (LRFD) Specification for Structural Steel Buildings.
   6. AISC Specification for the Design of Steel Hollow Structural Sections.
   7. AISC Specification for Allowable Stress Design of Single-Angle Members.
   8. AISC Load and Resistance Factor Design Specification for Single-Angle Members.
   9. RCSC Specification for Structural Joints Using ASTM A 325 or A 490 Bolts.

10. ASCE 19.

1.5 COORDINATION

A. Section {013000 - Administrative Requirements}: Requirements for coordination.

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

A. Structural W-Shapes: ASTM A992/A992M; Grade 50

B. Structural M-Shapes: ASTM A36/A36M; Grade 50

C. Structural T-Shapes: Cut from structural W-shapes.

D. Channels and Angles: ASTM A36/A36M.

E. Round Hollow Structural Sections: ASTM A500, Grade B.

F. Square and Rectangular Hollow Structural Sections: ASTM A500, Grade B.

G. Structural Plates and Bars: ASTM A36/A36M.

2.2 FASTENERS, CONNECTORS, AND ANCHORS

A. Bolts: ASTM A307; Grade A or B.
1. Finish: Unfinished

B. High Strength Bolts: ASTM A325; Type 1 or ASTM A490; Type 1.
1. Finish: Unfinished

C. Nuts: ASTM A563 heavy hex type.
1. Finish: Unfinished

D. Washers: ASTM F436; Type 1, circular
1. Finish: Unfinished

E. Threaded Rods: ASTM A36/A36M; Grade A.
1. Finish: Unfinished

F. Forged Structural Steel Hardware:
1. Clevises and Turnbuckles: ASTM A108; Grade 1085.
2. Eye Nuts and Eye Bolts: ASTM A108; Grade 1030.
3. Sleeve Nuts: ASTM A108; Grade 1018.
4. Rod Ends, Yoke Ends and Pins, Cotter Pins, and Coupling Nuts: Carbon steel.

2.3 WELDING MATERIALS

A. Welding Materials: AWS D1.1; type required for materials being welded.

2.4 ACCESSORIES

A. Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing minimum compressive strength of 7,000 psi at 28 days

B. Shop and Touch-Up Primer: SSPC Paint 15, Type 1, red oxide.

2.5 FABRICATION

A. Continuously seal joined members by continuous welds. Grind exposed welds smooth.

B. Fabricate connections for bolt, nut, and washer connectors.

C. Develop required camber for members.

2.6 FINISH

A. Prepare structural component surfaces in accordance with SSPC SP 3.

B. Shop prime structural steel members.

C. Galvanizing for Structural Steel Members: ASTM A123/A123M; minimum 1.2 oz/sq ft coating thickness; galvanize after fabrication.

D. Galvanizing for Fasteners, Connectors, and Anchors:
1. Hot-Dipped Galvanizing: ASTM A153/A153M.
2. Mechanical Galvanizing: ASTM B695; Class 50 minimum.

2.7 SOURCE QUALITY CONTROL AND TESTS

A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.

B. Shop test bolted and welded connections as specified for field quality control tests.

C. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify bearing surfaces are at correct elevation.

C. Verify anchors rods are set in correct locations and arrangements with correct exposure for steel attachment.

3.2 PREPARATION

A. Furnish templates for installation of anchor rods and embedments in concrete and masonry work.

3.3 ERECTION

A. Allow for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in alignment until completion of erection and installation of permanent bracing.

B. Field weld components and shear connectors indicated on Drawings.

C. Field connect members with threaded fasteners; tighten to snug tight for bearing type connections.

D. Do not field cut or alter structural members without approval of Architect/Engineer.

E. After erection, touch up welds and abrasions to match shop finishes.

3.4 GROUT INSTALLATION

A. Grout [under base plates in accordance with Section 036000.

B. Shim bearing plates and equipment supports to proper elevation, snug tighten anchor bolts.

C. Fill void under bearing surface with grout. Install and pack grout to remove air pockets.

D. Moist cure grout.

E. Remove forms after grout is set. Trim grout edges to from smooth surface, splayed 45 degrees.

F. Tighten anchor bolts after grout has cured for a minimum of 3 days.

3.5 ERECTION TOLERANCES

A. Section 014000 - Quality Requirements: Tolerances.

B. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

C. Maximum Offset From Alignment: 1/4 inch.

3.6 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Bolted Connections: Inspect in accordance with AISC specifications.
   1. Visually inspect all bolted connections.
   2. For Direct Tension Indicators, comply with requirements of ASTM F959. Verify that gaps are less than gaps specified in Table 2.

C. Welding: Inspect welds in accordance with AWS D1.1.
   1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
   2. Visually inspect all welds.
   3. Ultrasonic Inspection: ASTM E164; perform on all full penetration welds.
   4. Liquid Penetrant Inspection: ASTM E165.

D. Correct defective bolted connections and welds.

END OF SECTION

SECTION 05 21 00

STEEL JOISTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Open web steel joists and shear stud connectors, with bridging, attached seats and anchors.

B. Related Sections:
1. Section 051200 - Structural Steel: Superstructure framing.
2. Section 053110 – Steel Floor Deck
3. Section 053123 - Steel Roof Deck
4. Section 055000 - Metal Fabrications: Non-framing steel fabrications attached to joists.

1.2 REFERENCES

A. American Institute of Steel Construction:
1. AISC Seismic Provisions for Structural Steel Buildings.

B. ASTM International:
1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A108 - Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
3. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
6. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
7. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
8. ASTM F436 - Standard Specification for Hardened Steel Washers.
9. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

C. American Welding Society:
1. AWS D1.1 - Structural Welding Code - Steel.

D. Steel Joist Institute:
1. SJI K - Standard Specifications for Open Web Steel Joists, K-series.
2. SJI LH/DLH - Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series.
3. SJI JG - Standard Specification for Joist Girders.

E. SSPC: The Society for Protective Coatings:

1. SSPC - Steel Structures Painting Manual.
2. SSPC SP 1 - Solvent Cleaning.
3. SSPC SP 10 - Near-White Blast Cleaning.

1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Submittal requirements.

B. Shop Drawings:
1. Indicate standard designations, configuration, sizes, spacing, locations of joists, joist leg extensions.
2. Joist coding, bridging, connections, attachments.
3. Connection details.
4. Cambers

C. Welders' Certificates: Submit manufacturer's certificates, certifying welders employed on the Work, verifying AWS qualification within previous 12 months.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with the following:
1. Steel Joist Institute.

1.5 QUALIFICATIONS

A. Design connections not detailed on drawings under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Texas.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Product storage and handling requirements.

PART 2 PRODUCTS

2.1 MATERIALS

A. Manufactures: to be certified by SJI
1. Vulcraft Steel Joist
2. SEYCO Joist Company
3. Or approved equal

B. Open Web Joists Members: SJI Type K. LH Longspan. DLH Deep Longspan and joist Girders.

C. Nuts: ASTM A563 heavy hex type.
1. Finish: Unfinished

D. Washers: ASTM F436; Type 1

1. Finish: Unfinished

E. Structural Steel For Supplementary Framing and Joist Leg Extensions: ASTM A36/A36M.

F. Welding Materials: AWS D1.1; type required for materials being welded.

2.2 FABRICATION

A. Furnish bottom and top chord extensions as indicated on drawings.

B. Fabricate to achieves minimum end bearing of:
1. 2-1/2 inches on steel.
2. 4 inches on masonry.

2.3 FINISH

A. Shop prime joists and supplementary framing members. Do not prime surfaces that will be fireproofed.

B. Prepare joist component surfaces in accordance with SSPC SP 2.

2.4 SOURCE QUALITY CONTROL AND TESTS

A. Furnish shop testing and analysis of steel sections.

B. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 013000 - Administrative Requirements: Coordination and project conditions.

3.2 ERECTION

A. Erect and bear joists on supports.

B. Allow for erection loads. Install sufficient temporary bracing to maintain framing safe, plumb, and in alignment.

C. Coordinate placement of anchors in masonry construction for securing bearing plates.

D. After joist alignment and installation of framing, field weld joist seat to bearing plates or angles.

E. Position and field weld joist chord extensions and wall attachments as detailed.

F. Frame floor and roof openings greater than 18 inches with supplementary framing.

G. Do not permit erection of decking until joists are bridged, and secured or until completion of erection and installation of permanent bridging and bracing.

H. Do not field cut or alter structural members without approval of Architect/Engineer.

I. After erection, prime welds, abrasions, and surfaces not shop primed

3.3 ERECTION TOLERANCES

A. Section 014000 - Quality Requirements: Tolerances.

B. Maximum Variation From Plumb: ¼ inch.

C. Maximum Offset From Alignment: 1/4 inch.

3.4 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Field inspect members, connections, welds, and tightening of high strength bolts in slip-critical connections.

END OF SECTION

SECTION 05 31 23

STEEL ROOF DECK

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Steel roof deck and accessories.
2. Bearing plates and angles.

B. Related Sections:
1. Section 033000 - Cast-in-Place Concrete.
2. Section 035216 – Lightweight Insulating Concrete.
3. Section 051200 - Structural Steel.
4. Section 052100 - Steel Joists.

1.2 REFERENCES

A. American Society of Civil Engineers:
1. ASCE 3 - Standard Practice for the Construction and Inspection of Composite Slabs.

B. ASTM International:
1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
3. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
4. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

C. American Welding Society:
1. AWS D1.1 - Structural Welding Code - Steel.

D. Steel Deck Institute:
1. SDI 29 - Design Manual for Composite Decks, Form Decks and Roof Decks.

E. SSPC: The Society for Protective Coatings:
1. SSPC Paint 15 - Steel Joist Shop Paint.

1.3 PERFORMANCE REQUIREMENTS

A. Design metal deck in accordance with SDI 29 Design Manual and ASCE 3.

B. Calculate to structural working stress design and maximum vertical deck deflection of 1/240.

C. Design deck with maximum lateral diaphragm deflection of 1/500 of story height.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Submittal requirements.

B. Shop Drawings: Indicate deck plan, support locations, Projections, openings and reinforcement, pertinent details, and accessories.

C. Product Data: Submit deck profile characteristics and dimensions, structural properties, and finishes

D. Manufacturer’s Installation Instructions: Submit manufacturer's installation instructions.

E. Manufacturer’s Certificates: Certify Products meet or exceed specified requirements.

F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ASCE 3 for composite decks.

1.6 QUALIFICATIONS

A. Design deck layout, spans, fastening, and joints under direct supervision of Professional Engineer experienced in design of this Work and licensed. In State of Texas.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Product storage and handling requirements.

B. Cut plastic wrap to encourage ventilation.

C. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 PRODUCTS

2.1 MATERIALS

A. Sheet Steel: ASTM A653, Grade 33 Structural Quality; with G90 galvanized coating conforming to ASTM A525.

B. Bearing Plates or Angles: ASTM A36 steel.

C. Welding Materials: AWS D1.1.

2.2 FABRICATION

A. Metal Deck: Sheet steel, configured as follows:
   1. Span Design: multiple
   2. Minimum Metal Thickness Excluding Finish: 22 gage.
   3. Minimum Allowable Diaphragm Shear: 250 plf.

4. Nominal Height: 1-1/2 inch
5. Side Joints: lapped

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 013000 - Administrative Requirements: Coordination and project conditions.

3.2 INSTALLATION

A. Erect metal deck in accordance with SDI Manual.

B. Bear deck on steel supports with 1-1/2 3 inch minimum bearing. Align and level.

C. Fasten ribbed deck to steel support members at ends and intermediate supports with as indicated on drawings.

D. Weld in accordance with AWS D1.1.

E. Seal deck joints, laps, ends, and penetrations with sealant to achieve permanent air seal consistent with air barrier system specified in Section 07270.

F. Reinforce steel deck openings from 6 to 18 inches in size with 2 x 2 x 1/4 inch steel angles. Place framing angles perpendicular to flutes;extend minimum two flutes beyond each side of opening and mechanically attach to deck at each flute.

G. Install wet concrete stops at roof edge upturned to top surface of slab to contain wet concrete. Install stops of sufficient strength to remain stationary under wet concrete without distortion.

H. Install sheet steel closures and angle flashings to close openings between deck and walls, columns, and openings.

I. Position roof sump pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

J. Place metal cant strips in position and mechanically attach.

K. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up prime paint.

3.3 FIELD QUALITY CONTROL

A. Welding: Inspect welds in accordance with AWS D1.1.

END OF SECTION

SECTION 05 40 00 – COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Ceiling joist framing.
   2. Soffit framing.
   3. Accessories necessary for a complete installation.

1.3 RELATED SECTIONS

A. Section 05 50 00 – Metal Fabrications.

B. Section 09 21 16 – Gypsum Board Assemblies.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: General Contractor shall engage a qualified professional engineer, licensed in the State of Texas, to design cold formed steel framing.

B. Structural Performance: Delegated design engineer shall provide cold-formed steel framing designs capable of withstanding all code required design loads within limits and under conditions indicated on the construction documents and within this specification.
   1. Design Loads: Designs shall be capable of withstanding the worst case loading as indicated on the Structural Drawings, and/or as required by the locally adopted Building Code. The design shall cover the worst case loading in all instances.
   2. Coordinate the requirements on the Structural and Architectural Drawings with the requirements of this Section. If a conflict exists, notations on the Structural Drawings take precedence.
   3. The following document governs the Work, except where more restrictive items are specified:
      a. AISI Design of Cold-Formed Steel Structural Members Wind Load
         Minimum Design Loads for exterior and/or load bearing and/or soffit applications:
         1. As required by code officials having jurisdiction.
         2. Deflection: 1/600 for clear simple spans
         3. Deflection: 1/300 for cantilever conditions and roof parapets
         4. Gauge: 16 gauge minimum, unless noted otherwise.

      b. Minimum Design Loads for interior and/or exterior suspended furr-downs with a maximum vertical drop on either side of 5’-0” or greater:
         1. As required by code officials having jurisdiction.
         2. Deflection: 1/600 for clear simple spans
         3. Deflection: 1/300 for cantilever conditions and roof parapets
         4. Gauge: 20 gauge minimum, unless noted otherwise.
         5. It is a common practice for studs with thinner than 20 gauge to be crimped and/or ribbed to increase the strength of the overall stud cross section for various loading applications. These studs are typically noted by manufacturer as “Equivalent” to a thicker gauge. These “Equivalent” type studs are not

allowed in a vertically suspended application with greater than 5'-0" of vertical wall drop, 20 Gauge is the minimum thickness allowed for these applications.

4. Welding Qualifications: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".

5. Studs, tracks, channels, and other light gauge framing members shall conform to requirements of ASTM C955.

6. Fire-Rated Assemblies: Where framing units are components of assemblies indicated for a fire-resistance rating, including those required for compliance with governing regulations, provide units that have been approved by governing authorities that have jurisdiction.

7. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 degrees F (67 degrees C).

8. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure:
   a. Upward and downward movement of 1-1/2 inches (38 mm).

9. Design exterior nonload bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold Formed Steel Framing Design Standards:
   1. Floor and Roof Systems: AISI S210.
   2. Headers: AISI S212.
   3. Lateral Design: AISI S213.

1.5 SUBMITTALS

A. Product Data: Technical data for cold formed steel framing product and accessories including factory applied primers.

B. Shop Drawings: Submit layout, spacings, sizes, thickness, and types of cold formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   1. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Supplementary Design Details: The general design is presumed adequate to permit compliance with the specified performance. Provide engineering calculations to supplement the general design. Calculations shall bear the seal of a Registered Professional Engineer, licensed in the State of Texas. Calculations must show design will with stand wind loading commiserate with class and rating of the project.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Welding Qualifications: Qualify procedures and personnel according to the following:
      a. AWS D1.1/D1.1M Structural Welding Code - Steel.
      b. AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.
      c. CCFSS Technical Bulletin: "AISI Specification Provision for Screw Connections."

2. Comply with AISI North American Specification for the Design of Cold Formed Steel Structural Members and Standard for Cold Formed Steel Framing - General Provisions.
   a. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

3. Fire Resistance Ratings: ASTM E 119; testing by a UL. Identify products with appropriate markings of applicable testing agency. Indicate design designations from UL *Fire Resistance Directory*.
4. Installer Qualifications: Company specializing in the installation of cold formed metal framing components with minimum five years documented experience.
5. Install system to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
6. Install system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
7. Mill certificates signed by steel sheet producer indicating steel sheet complies with requirements, including uncoated steel thickness, yield strength, tensile strength, total elongation, chemical requirements and galvanized-coating thickness

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of Texas and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold formed metal framing that are similar to those indicated in material, design, and extent.
   1. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and structural data.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect cold formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. CEMCO; California Expanded Metal Products Co.
   2. ClarkDietrich Building Systems.
   3. Consolidated Fabricators Corp.; Building Products Division.
   4. Marino\WARE.
   5. SCAFCO Corporation.
   6. The Steel Network.

2.2 CEILING JOIST FRAMING

A. Steel Ceiling Joists: C shaped steel sections, of web depths indicated, punched with standard holes, with stiffened flanges:
   1. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm).
   2. Flange Width: 2 inches (51 mm), minimum.

2.3 SOFFIT FRAMING

A. Exterior Soffit Frame: C shaped steel sections, of web depths indicated, with stiffened flanges:

1. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm)] [0.0538 inch (1.37 mm).
2. Flange Width: 1-5/8 inches (41 mm) minimum.

2.4 FRAMING ACCESSORIES

A. Fabricate steel framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of appropriate thickness and configuration, unless otherwise indicated:
1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

C. Anchors, Clips, and Fasteners:
1. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot dip process according to ASTM A 123/A 123M.
2. Expansion Anchors: Fabricated from corrosion resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
3. Power Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
4. Mechanical Fasteners: ASTM C 1513, corrosion resistant coated, self-drilling, self-tapping, steel drill screws.
    a. Head Type: Low profile head beneath sheathing.

5. Welding Electrodes: Comply with AWS standards.

D. Miscellaneous Materials:
1. Galvanizing Repair Paint: SSPC-Paint 20 or ASTM A 780.
2. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage compensating agents, and plasticizing and water reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30 minute working time.
3. Shims: Load bearing, high density multimonomer plastic, and nonleaching; or of cold formed steel of same grade and coating as framing members supported by shims.
4. Sealer Gaskets: Closed cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from standard widths to match width of bottom track or rim track members.

2.5 FABRICATION

A. Fabricate cold formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI specifications and standards, manufacturer written instructions, and specified requirements.
1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.

3. Fasten cold formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
   a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
   1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
   2. Squareness: Fabricate each cold formed steel framing assembly to a maximum out of square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

3.2 PREPARATION

A. Before sprayed fire resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire resistive materials, remove only as much as necessary to complete installation of cold formed framing without reducing thickness of fire resistive materials below required thickness to obtain fire resistance rating indicated. Protect remaining fire resistive materials from damage.

C. Install load bearing shims or grout between the underside of load bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 ERECTION

A. General:
   1. Track Anchors: Install anchors maximum 4 feet - 0 inches on center; design anchors and spacing to carry live, dead and wind loads.
   2. Track Splices: Provide channel inserts or weld track splices.
   3. Erection: Install members plumb, level, and in a true plane.
   4. Fastenings: Make assembly rigid and secure, with welds free of voids and burnouts.

B. Install metal framing systems in accordance with stud manufacturer's printed instructions.

E. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.

F. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure. Use Zee clips as specified above. Weld "Z" shaped clips to structural members as shown on drawings. Maximum 2 feet on center vertical.

G. Install supplementary framing, blocking and bracing in the metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with the stud manufacturer's recommendations and industry standards in each case, considering the weight or loading resulting from the item supported.

H. Frame wall openings with extra studs, equal to the number of studs interrupted by wall openings, placed at each side of wall openings. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with shoes or by welding, and space jack studs same as full-height studs of the wall. Secure stud system all around to wall opening frame in the manner indicated.

I. Install bracing/bridging in accordance with manufacturer’s instructions and design conditions.

J. Touch up field welds and damaged galvanized coating, except touch up of field cut studs is not required.

K. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of stud system.

L. Install horizontal stiffeners in stud system, space (vertical distance) at no more than 54 inches on center. Weld at each intersection.

3.4 JOIST INSTALLATION

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
   1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
   2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel stud sections as indicated on Shop Drawings.

C. Space joists not more than 2 inches (51 mm) from abutting walls:
   1. Joist Spacing: 16 inches (406 mm).

D. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on Shop Drawings.
   1. Install web stiffeners to transfer axial loads of walls above.

F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:
   1. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

G. Secure joists to load bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold down angles, anchors, and fasteners, to provide a complete and stable joist framing assembly.

END OF SECTION 05 40 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Steel framing and supports for countertops.
   2. Steel framing and supports for mechanical and electrical equipment.
   3. Accessories necessary for a coordinated and complete installation.

1.3 DEFINITIONS

A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance:
   1. Countertops and Vanities: Provide countertop and vanity framing capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections, or of exhibiting excessive deflections in any of the components making up the countertops and vanities:
      a. All deadloads.
      b. 500 pound live load placed on the countertop and vanity.
      c. Deflection at Midspan: L/1000 times span or 1/8 inch whichever is less.

B. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

1.5 SUBMITTALS

A. Product Data: Submit data for miscellaneous metal fabrications and paint, coatings, and grout accessories.

B. Shop Drawings: Submit shop drawings detailing the fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
   1. For installed products indicated to comply with design loads, include structural analysis data, for information only, signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates.

D. Paint Compatibility Certificates: Submit manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Building Code: Comply with applicable requirements of the IBC for metal fabrications.
   2. Welding: Qualify procedures and personnel according to the following:
      a. AWS D1.1/D1.1M Structural Welding Code - Steel.
      b. AWS D1.2/D1.2 M Structural Welding Code - Aluminum.
      c. AWS D1.6/D1.6M Structural Welding Code - Sheet Steel.
      d. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

B. Fabricator/Installer Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project for a minimum of 5 years, with a record of successful in service performance, with sufficient production capacity to produce required units without causing delay in the Work.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
   2. Provide allowance for trimming and fitting at site.

1.8 STORAGE, DELIVERY AND HANDLING

A. Store metal fabrications in a dry, well ventilated, weathertight place. Deliver and handle so as to prevent any type of damage to the fabricated Work.

1.9 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other Work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.10 CONTRACTOR'S RESPONSIBILITIES

A. As scope and performance documents, the Drawings and Specifications do not necessarily indicate or describe all the work required for the performance and completion of the Work. Contracts will be let on the basis of such documents with the understanding that the Contractor shall furnish and install the items required for proper completion of the Work without adjustment to price or schedule. Work shall be of sound, quality construction and the Contractor shall be solely responsible for the inclusions of adequate labor and materials to cover the proper and

timely fabrication and installation of the miscellaneous metal items indicated, described, or implied.

B. As a performance specification, the criteria for the solution of structurally sound miscellaneous metal items indicated on the Drawings or specified herein are the sole purpose of defining the design intent and performance requirements. The details shown are intended to emphasize the acceptable profiles and performance requirements for this Project. To avoid any misunderstanding or lack of interpretation, the Contractor is hereby advised that the responsibility for the miscellaneous metal items are totally his and that designs and resolutions proposed in the Contractor's shop drawings, structural calculations, and related documentation shall be demonstrated throughout the Work and warranty period specified or required.

C. Design proposal submissions which follow exactly the details indicated on the Drawings, will not relieve the Contractor of his responsibility for the design, fabrication, erection, or performance of the Work of this Section.

D. In the event of a controversy over the design, the decision of the Architect will take precedence.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Stainless Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.

D. Stainless Steel Bars and Shapes: ASTM A 276, Type 304.

E. Rolled Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

F. Rolled Stainless Steel Floor Plate: ASTM A 793.

G. Abrasive Surface Floor Plate: Steel plate with abrasive granules rolled into surface or with abrasive material metallically bonded to steel.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. IKG Industries, a division of Harsco Corporation.
      b. SlipNOT Metal Safety Flooring; W.S. Molnar Company.

H. Steel Tubing: ASTM A 500/A 500M, cold formed steel tubing.

I. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

J. Slotted Channel Framing: Cold formed metal box channels (struts) complying with MFMA-4.
   1. Size of Channels: 1-5/8 inches by 1-5/8 inches (41 mm by 41 mm).
   2. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B. with G90 (Z275) coating; [0.108 inch (2.8 mm) nominal thickness.
   3. Cold Formed Metal Channels: Flange edges returned toward web and with 9/16 inch (14.3 mm) wide slotted holes in webs at 2 inches (51 mm) o.c.
   4. Width of Channels: 1-5/8 inches (41 mm).

5. Depth of Channels: Indicated on Drawings.
6. Metal and Thickness: Galvanized steel complying with ASTM A 653/A 653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating; 0.108 inch (2.8mm) nominal thickness.
7. Finish: Hot dip galvanized after fabrication.

K. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.

L. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

M. Aluminum Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

N. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

O. Fasteners: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
1. Provide stainless steel fasteners for fastening aluminum.
2. Provide stainless steel fasteners for fastening stainless steel.
3. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
4. Steel Bolts and Nuts: Regular hexagon head bolts, ASTM A 325, Type 3 (ASTM A 325M, Type 3); with hex nuts, ASTM A 563, Grade C3 (ASTM A 563M, Class 8S3); and, where indicated, flat washers.
5. Stainless Steel Bolts and Nuts: Regular hexagon head annealed stainless steel bolts, ASTM F 593 (ASTM F 738M); with hex nuts, ASTM F 594 (ASTM F 836M); and, where indicated, flat washers; Alloy.
6. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
   a. Hot dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

7. Anchors: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
8. Cast in Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot dip galvanized per ASTM F 2329.
9. Post Installed Anchors: Torque controlled expansion anchors or chemical anchors.
   a. Material for Interior Locations: Carbon steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
   b. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 (A4) stainless steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

10. Slotted Channel Inserts: Cold formed, hot dip galvanized steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee head bolts, complete with washers and nuts, all zinc plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

P. Miscellaneous Materials:
   1. Shop Primer for Ferrous Metal: Universal primer, organic zinc rich primer, complying with SSPC-Paint 20 and compatible with topcoat. Provide 10-99 (red) or 10-09 (gray) by Tnemec Company.
   2. Universal Shop Primer: Fast curing, lead and chromate free, universal modified alkyd primer and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc rich primer.
   3. Water Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel and compatible with topcoat.
   4. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc coated metal and compatible with finish paint systems indicated.
   5. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20. Provide Tneme-Zinc 90-97 by Tnemec Company.
   6. Bituminous Paint: Cold applied asphalt emulsion complying with SSPC-Paint 12, containing no asbestos fibers, or cold applied asphalt emulsion complying with ASTM D 1187 ASTM D 1187/D 1187M.
   7. Nonshrink, Nonmetallic Grout: Factory packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
   8. Concrete Materials and Properties: Composed of ASTM C150 Type I Portland cement, ASTM C33 sand and coarse aggregates and potable water to produce a low slump mix suitable for placement. Grade coarse aggregate from 1/8” with at least 95 % passing a 3/8” sieve and not more than 10% passing a No. 8 sieve. Fill shall be proportioned to provide a minimum 28 day compressive strength of 3000 psi (20 MPa).

2.2 FABRICATION

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
   1. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
   2. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing Work.
   3. Form exposed Work with accurate angles and surfaces and straight edges.
   4. Weld corners and seams continuously to comply with the following:
      a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
      b. Obtain fusion without undercut or overlap.
      c. Remove welding flux immediately.
      d. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

   5. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
   6. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
   7. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

8. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
9. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 inch by 1-1/2 inches (3.2 mm by 38 mm), with a minimum 6 inch (150 mm) embedment and 2 inch (50 mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

B. Miscellaneous Framing and Supports: Provide steel framing and supports necessary to complete the Work and which are not a part of the structural framework, including but not limited to framing and supports for countertop and vanities and mechanical and electrical equipment.
1. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction. Cut, drill, and tap units to receive hardware, hangers, and similar items.
   a. Fabricate units from slotted channel framing where indicated.
   b. Furnish inserts for units installed after concrete is placed.

2. Countertop and Vanity Framing: Custom fabricate countertop and vanity framing, using steel shapes and plates, and cold finished mild steel bars at exposed conditions, for support framing and plywood, to the thicknesses, sizes and shapes shown, and as required to produce Work of adequate strength and durability, without objectionable deflections. Use proven details of fabrication, as required, to achieve proper assembly and alignment of the various components of the Work.
3. Galvanize miscellaneous framing and supports at exterior locations; prime paint

C. Shelf Angles: Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4 inch (19 mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.
3. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
4. Galvanize and prime shelf angles located in exterior walls.
5. Prime shelf angles located in exterior walls with zinc rich primer.
6. Furnish wedge type concrete inserts, complete with fasteners, to attach shelf angles to cast in place concrete.

2.3 MISCELLANEOUS STEEL TRIM

A. Miscellaneous Steel Trim: Unless otherwise indicated, fabricate units from structural steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
1. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other Work.
   a. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction, spaced not more than 6 inches (150 mm) from each end, 6 inches (150 mm) from corners, and 24 inches (600 mm) o.c.

2. Cast in Pit Angles and Edge Angles: Provide edge angles, and pit angles, fabricated from angles of size as shown, or required, with welded on stud anchors spaced 24 inches (600 mm) on center. Provide pit and edge angles in as long lengths as possible. Miter and weld corners and provide splice plates for alignment between sections.

3. Galvanize miscellaneous steel trim.

2.4 PIPE BOLLARDS

A. Pipe Bollards: Fabricate metal bollards from Schedule 40 steel pipe or 1/4 inch (6.4 mm) wall thickness rectangular steel tubing.
   1. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
   2. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
   3. Where installation on structural slab or existing paving.
   4. Fabricate bollards with 3/8 inch (9.5 mm) thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4 inch (19 mm) anchor bolts.
      a. Where bollards are anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.

   5. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4 inch (6.4 mm) thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard.

2.5 PIPE DOWNSPOUT GUARDS

A. Fabricate pipe downspout guards from 3/8 inch (9.5 mm) thick by 12 inch (300 mm) wide steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2 inch (50 mm) clearance between pipe and pipe guard. Drill each end for two 3/4 inch (19 mm) anchor bolts.

B. Galvanize and prime pipe downspout guards.

2.6 METAL DOWNSPOUT BOOTS

A. Downspout Boot: Provide downspout boots made from aluminum in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.
   1. Outlet: Horizontal, to discharge into pipe.
   2. Prime cast iron downspout boots with zinc rich primer.

2.7 LOOSE BEARING AND LEVELING PLATES

A. Loose Bearing and Leveling Plate: Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
   1. Galvanize plates.

2.8 LOOSE STEEL LINTELS

A. Loose Steel Lintels: Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
   1. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches (200 mm) unless otherwise indicated.
   2. Galvanize and prime loose steel lintels located in exterior walls.

2.9 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.10 FABRICATION TOLERANCES

A. Squareness: 1/8 inch (3mm) maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch (1.5mm).

C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5mm).

D. Maximum Bow: 1/8 inch (3mm) in 48 inches (1.2m).

E. Maximum Deviation From Plane: 1/16 inch (1.5mm) in 48 inches (1.2m).

2.11 FINISHES

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surfaces.

2.12 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
   1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
   1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   4. Other Items: SSPC-SP 3, "Power Tool Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

F. Stainless Steel Finishes: Remove tool and die marks and stretch lines or blend into finish.
   1. a. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
   2. b. Bright, Directional Polish: No. 4 finish.

3. c. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.13 ALUMINUM FINISHES

A. As-Fabricated Finish: AA-M12.

B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.
1. 1. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
   1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

3.3 INSTALLING METAL BOLLARDS

A. Fill metal capped bollards solidly with concrete and allow concrete to cure seven days before installing.

3.1 ERECTION TOLERANCES

A. Maximum Variation from Plumb: 1/4 inch (6mm) per story, noncumulative.

B. Maximum Offset from True Alignment: 1/4 inch (6mm).

C. Maximum Out of Position: 1/4 inch (6mm).

3.2 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop painted surfaces.
   1. Apply by brush or spray to provide a minimum 2.0 mil (0.05 mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099000.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 50 00

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. All rough carpentry items including, but not limited to:
   1. Wood blocking for support of items supported on or recessed into wood framing or requiring wood blocking for support, including but not limited to casework, TV mounts, marker boards, metal shelving, toilet partitions, toilet accessories and window blinds, door strikes, wall stops, wall panels.
   2. Wood cants, nailers, curbs, and other items associated with roofing work.
   3. Miscellaneous framing items and plywood sheathing.

1.3 RELATED WORK

A. All Sections of Work supported on or recessed into wood framing or requiring wood blocking for support, such as wall trim, wall cabinets, handrails, lockers, toilet compartments, toilet and bath accessories, markerboards, tackboards, projection screens, fire extinguisher cabinets, etc., as applicable to the Project.

1.4 SUBMITTALS

A. Product Data: Manufacturer’s data on wood treatment materials.

1.5 STANDARDS AND GRADING

A. All lumber used structurally shall be graded and marked with grade and trademark of a lumber grading organization approved by the Architect, except that a certification of grade from such a grading organization may be accepted in lieu of grade and trademarks when approved by Architect. Trademark of manufacturer shall also appear on each piece.

B. Each piece of plywood used structurally shall carry the American Plywood Association trademark.

C. Grading Rules: Conform with all applicable requirements of American Lumber Standards "Simplified Practice Recommendations R-16" and to grading rules of manufacturer's association under whose rules the lumber is produced.

D. Reference Standards: Conform with all requirements.
   1. U.S. Dept. of Commerce Product Standards (PS).
   2. American Plywood Association (APA).
      a. Standards and Construction Guide.

   3. American Wood Preservers Association (AWPA).
      a. Standards, as they apply.

   4. Architectural Woodwork Institute (AWI)
      a. "Quality Standards."

5. National Woodwork Manufacturers' Association (NWMA).
   a. Standards.

6. Western Wood Products Association (WWPA).
   a. Manual.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber:
   1. Treated No. 2, S4S Southern Yellow Pine, #1 kiln dried.
      a. Comply with NWMA Standards
      b. Use for blocking, stripping, grounds, cants and miscellaneous wood items in contact with concrete, roofing, or exposed to the weather.

   2. No. 2, S4S Southern Yellow Pine: Use for framing, blocking, stripping and miscellaneous concealed interior lumber not exposed to concrete, roofing weather or moisture, when FRS lumber is not required by building code.
   3. Fire Retardant No, 2, S4S Southern Pine: Refer to Fire Retardant Treatment below. Use for framing, plates and blocking in all walls and partitions where required by building code or noted on drawings.

B. Plywood:
   1. General: Comply with APA Standards.
   2. APA A-D, Group 1 Interior used where appearance of only one side is exposed to view for interior locations. Use for wall liner at MDF/IDF closets and telephone boards in mechanical and telephone rooms. 3/4 inch thick unless required or shown otherwise. Paint per Section 09 91 00.
   3. Exterior plywood, Group 1, APA rated sheathing. Use where miscellaneous plywood is exposed to concrete, weather, or at roof construction as sheathing.
   4. Fire Retardant Treated Plywood: Refer to Fire Retardant Treatment below. Use when required by building code or noted on drawings.
   5. Underlayment: If shown or required, APA rated Sturdi-floor, exterior grade, tongue and groove edges.
   6. APA C-D, Interior DFPA grade-use at mechanical rooms, electrical closets, etc, where wall mounted panels are required for equipment.

C. Rough Hardware:
   1. Nails, Spikes, and Staples: Galvanized for exterior locations, high humidity locations, and treated wood; plain finish for other interior locations: Size and type to suit application. Do not use to resist "pull-out" loads.
   2. Bolts, Nuts, Washers, Lags, and Screws: Medium carbon steel; size and type to suit application. Galvanize for exterior locations, high humidity locations, and treated wood. Plain finish for other interior locations.
   3. Fasteners: Toggle bolt type for anchorage to hollow masonry. Expansion shield and lag bolt type for anchorage to solid masonry and concrete. Bolts or power activated type for anchorage to steel.

D. Wood Treatment:
   1. Preservative Treatment (Concealed Conditions):
      a. Micronized Copper Quaternary (MCQ): Pressure impregnate preservative to net retention of 0.25 lbs./cu.ft., in plant licensed by manufacturer in accordance with the following standards:
         1) Preservative Treatment Standard: AWPA P5.
         2) Structural Lumber Treatment Standard: AWPA C31.

3) Plywood Treatment Standard: AWPA C9.

b. Brush two (2) coats of preservative on bored or sawn surfaces of treated lumber.
c. Provide Quality Mark Stamp on treated wood for identification.
d. Fasteners: Metal fasteners in contact with preservative treated wood shall be G-90 galvanized, minimum, or stainless steel in accordance with manufacturer's instructions. No uncoated steel shall come in contact with preservative wood.
e. ACQ and CCA preservatives not permitted.
f. Acceptable Manufacturers: Osmose "MicroPro" Smart Sense; or Architect approved equal.

2. Fire Retardant Treatment:
   a. Lumber shall be pressure-impregnated with non-combustible fire retardant chemicals in accordance with U.L. FRS Fire Hazard Classification. All lumber must be dried following treatment in accordance with AWPA Standard C20.
   b. Plywood shall be pressure-impregnated with non-combustible fire retardant chemicals in accordance with U.L. FRS Fire Hazard Classification. All plywood must be dried following treatment in accordance with AWPA Standards C27.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Wood Framing:
1. Framing and blocking shall be accurately cut and fitted true to line and levels, avoiding shims and wedges.
2. Wood blocking for wall mounted accessories to be fire retardant.
3. Steel plate installed at location of door hardware impact, 12 inch x 12 inch, where hardware could strike wall. Refer to Division 5.
4. All interior wood blocking shall be fire resistant.
5. All interior wood blocking shall be exterior grade fire resistant.
6. Spiking and nailing shall be done using largest size spikes and nail practicable.
7. Unless otherwise shown, use 2 inch by 4 inch wood studs spaced 16 inches o.c. with 4 inch face perpendicular to direction of wall or partition. Provide single bottom plate and double-top plates 2 inches thick by width of studs.
8. Bolt nailers and blocking to steel, masonry or concrete members with bolts or proportionate strength of members attached from each end, except as otherwise noted on plans.
9. Provide blocking, bucks and framing as necessary and for other trades as required.
10. Drill lumber accurately for bolts and fit all bolts with suitable washers.
11. Perimeter wood blocking to be attached 2'-0" staggered with 1/2" galvanized bolts through both nailers.
12. Screws are to be used for perimeter edge nailers. No nailing permitted.

B. Plywood:
1. Install plywood over framing in accordance with instruction of American Plywood Association Construction Guide Form No. E30C.
2. Install underlayment plywood as shown in accordance with instructions of American Plywood Association. Space panel joints and edges 1/32 inch. Fill and sand panel edge joints, surface roughness, and damaged or open areas. Nail with 4d ring-shank nails spaced at six (6) inches at edges and eight (8) inches in field each way.

END OF SECTION 06 10 00

SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Framing with dimension lumber.
   2. Rooftop equipment bases and support curbs.
   3. Wood blocking, cants, and nailers.
   4. Wood furring and grounds.
   5. Wood sleepers.
   6. Accessories necessary for a complete installation.
   7. Plywood backing panels.
   8. Accessories necessary for a complete installation.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater size but less than 5 inches nominal (114 mm actual) size in least dimension.

1.4 SUBMITTALS

A. Product Data: Submit each type of process and factory fabricated product. Indicate component and materials and dimensions and include construction and application details.
   1. Wood Treatment: Submit data for wood preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
      a. Include data for fire retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by qualified independent testing agency.
      b. For fire retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
      c. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to site.

B. Laboratory and Testing Reports:
   1. Laboratory Test Reports: Submit report for installation adhesives indicating compliance with requirements for low emitting materials.
   2. Post installed anchors.
   3. Metal framing anchors.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Building Code: Comply with applicable requirements of IBC Chapter 23 for miscellaneous wood.
   2. Fire Retardant Treated Lumber and Plywood by Pressure Process: Provide products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

B. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
   3. Dress lumber, S4S, unless otherwise indicated.
   4. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

B. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
   2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
   3. Kiln dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
   4. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
   5. Application: Treat items indicated on Drawings, and the following:
      a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
      b. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

C. Fire Retardant Treatment: Where indicated as fire retardant treated, provide materials acceptable to authorities having jurisdiction, and with fire test response characteristics specified as determined by testing identical products per ASTM E 84 by a qualified testing agency.
   1. Treatment shall not promote corrosion of metal fasteners.
   2. Exterior Type: Comply with specified requirements for fire retardant treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
   3. Interior Type A: Provide treated materials with moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
   4. Design Value Adjustment Factors: Test treated lumber according to ASTM D 5664, and calculate design value adjustment factors according to ASTM D 6841.
      a. For enclosed roof framing, framing in attic spaces, and where high temperature fire retardant treatment is indicated, provide material with adjustment factors of minimum 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for climatological zone.

   5. Kiln dry lumber after treatment to a maximum moisture content of 19 percent.
   6. Identify fire retardant treated wood with appropriate classification marking of qualified testing agency.
      a. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

   7. For exposed items indicated to receive a stained or natural finish, verify chemical formulations shall not bleed through, contain colorants, or adversely affect finishes.
   8. Application: Treat items indicated on Drawings, and the following:
      a. Framing for raised platforms.
      b. Concealed blocking.
      c. Roof framing and blocking.
      d. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
      e. Plywood backing panels.

D. Dimension Lumber Framing:
   1. Non Load Bearing Interior Partitions: Construction or No. 2 grade of any species.
   2. Other Framing: Construction or No. 2 grade of any species.

E. Miscellaneous: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including but not limited to blocking, nailers, cants, grounds, furring, roof top equipment bases and support curbs, and utility shelving.
   1. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content of any species.
   2. For blocking not used for attachment of other construction, use Utility, Stud, or No. 3 grade lumber of any species provided that it is cut and selected to eliminate defects that interfere with attachment and purpose.
   3. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that interfere with attachment of work.
   4. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.
   5. Utility Shelving: Lumber with 19 percent maximum moisture content of any of the following species and grades:
      a. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Premium or No. 2 Common (Sterling) grade; NeLMA, NLGA, WCLIB, or WWPA.
      b. Mixed southern pine or southern pine No. 2 grade; SPIB.
      c. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

F. Concealed Boards: 19 percent maximum moisture content of any of the following species and grades:
   1. Mixed southern pine or southern pine, No. 2 grade; SPIB.
   2. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
   3. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
   4. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
   5. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

G. Plywood Backing Panels:
   1. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, C-C Plugged or Exposure 1, C-D Plugged, fire retardant treated, in thickness not less than 3/4 inch (19 mm)] nominal thickness.

H. Fasteners: Provide fasteners of size and type indicated that comply with requirements.
   1. Where carpentry is exposed to weather, in ground contact, pressure preservative treated, or in area of high relative humidity, provide fasteners with hot dip zinc coating complying with ASTM A 153/A 153M.
   2. Nails, Brads, and Staples: ASTM F 1667.
   3. Screws for Fastening to Metal Framing: ASTM C 1002 drywall type or ASTM C 954 nonload bearing steel stud, length recommended by screw manufacturer for material being fastened.
   4. Power Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
   5. Post Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 mechanical, masonry, ICC-ES AC58 mechanical, concrete, ICC-ES AC193 adhesive, masonry, or ICC-ES AC308 adhesive, concrete as appropriate for the substrate.
      a. Material, Interior: Carbon steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
      b. Material, Exterior: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

I. Metal Framing Anchors:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Cleveland Steel Specialty Co.
      b. KC Metals Products, Inc.
      c. Phoenix Metal Products, Inc.
      d. Simpson Strong-Tie Co., Inc.

   2. Galvanized Steel Sheet: Hot dip, zinc coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation. Use for interior locations unless otherwise indicated.
   3. Hot Dip, Heavy Galvanized Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high strength low alloy steel Type A (HSLAS Type A), or high strength low alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick. Use for wood preservative-treated lumber and where indicated.
   4. Stainless Steel Sheet: ASTM A 666, Type 304 and Type 316 for exposed application in coastal environments. Use for exterior locations and where indicated.

J. Miscellaneous Materials:
   1. Adhesives for Gluing to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
   2. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized asphalt compound, bonded to high density polyethylene film, aluminum foil, or spunbonded polyolefin to produce overall thickness of not less than 0.025 inch (0.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Framing Standard: Comply with AF&PA WCD 1 *Details for Conventional Wood Frame Construction* unless otherwise indicated.

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.
   1. Install fire retardant treated plywood backing panels with classification marking of testing agency exposed to view.

D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
   1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.

G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
   1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
   2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal (38-mm actual) thickness.
   3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
   4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.

H. Sort and select lumber so natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

I. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative treated lumber.
   1. Use inorganic boron for items that are continuously protected from liquid water.
   2. Use copper naphthenate for items not continuously protected from liquid water.

J. Where wood preservative treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

K. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. Table 2304.9.1 *Fastening Schedule* in the International Building Code.
   2. ICC-ES evaluation report for fastener.

L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

M. Wood Blocking and Nailer Installation: Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
   1. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
   2. Provide permanent grounds of dressed, pressure preservative treated, key beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.2 SITE ENVIRONMENTAL PROCEDURES

A. Indoor Air Quality: Temporary ventilation: Provide temporary ventilation during work. During and immediately after installation of treated wood, engineered wood products, and laminated wood products at interior spaces, provide temporary ventilation.

B. Waste Management: Refer to Section 017400 and Construction Waste Management Plan:
   1. Select lumber sizes to minimize waste; reuse scrap lumber to the greatest extent possible. Clearly separate scrap lumber for use on site as accessory components, including: shims, bracing, and blocking.
   2. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
   3. Prevent saw dust and wood shavings from entering the storm drainage system.
   4. Do not burn scrap lumber that has been pressure treated.
   5. Do not send lumber treated with pentachlorophenol, CCA, or ACA to cogeneration facilities or waste to energy facilities.

3.3 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron treated wood becomes wet, apply EPA registered borate treatment. Apply borate solution by spraying to comply with EPA registered label.

B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA registered borate treatment. Apply borate solution by spraying to comply with EPA registered label.

END OF SECTION 06 10 53

SECTION 061213

STRUCTURAL PANEL CONCRETE ROOF DECK

PART 1 - GENERAL

1.01 SUMMARY

A. Description of Work: Work of this Section includes, but is not limited to, the following:
   1. Framing.
   2. Fasteners.
   3. Roof deck construction

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. See Section 05 20 00, Metal Joists
B. See Section 05 40 00, Cold-Formed Metal Framing
C. See Section 06 10 00, Rough Carpentry
D. See Section 06 16 00, Sheathing
E. See Section 07 01 00, Operation and Maintenance of Thermal and Moisture Protection
F. See Section 07 41 00, Roof Panels
G. See Section 13 40 00, Integrated Construction

1.03 SYSTEM DESCRIPTION

USG Structural Panel roof deck system consists of steel joists, trusses or framing members and USG Structural Panel Concrete roof deck installed with mechanical fasteners. USG Structural Panel Concrete roof deck is a high-strength reinforced concrete panels for use in noncombustible construction, as required by the applicable building codes. Adhesives are not recommended, nor required to enhance shear performance. A suitable approved exterior roof system shall be used to complete the envelope.

1.04 REFERENCES

A. ICC-ES AC318 – Acceptance Criteria for Structural Cementitious Floor and Roof Sheathing Panels
B. ICC-ES AC319 – Acceptance Criteria for Horizontal Diaphragms Consisting of Structural Cementitious Floor Sheathing Panels Attached to Cold-Formed Steel Framing
C. ASTM A588/A588M – Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50ksi [345MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance
D. ANSI/AISI S100 – North American Specification for the Design of Cold-Formed Steel Structural Members
E. ANSI/AISI S210 – North American Specification for Cold-Formed Steel Framing – Floor and Roof System Design
F. ANSI/AISI S214 – North American Specification for Cold-Formed Steel Framing – Truss Design

G. ANSI/AISI S230 – Standard for Cold-Formed Steel Framing – Prescriptive Method for One and Two Family Dwellings
H. ASTM E84-14 – Standard Test Method for Surface Burning Characteristics of Building Materials
I. ASTM E119-14 – Standard Test Method for Fire Tests of Building Construction and Materials
J. ASTM E136-12 – Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750° C

1.05 SYSTEM REQUIREMENTS

A. Performance Requirements: Fabricate and install systems as indicated:
   1. Roof Framing:
      a. Standard systems: Roof framing shall be design with a minimum deflection of L/360, where the Uniform Floor Load is 150 PSF (7.2kPa) (Ultimate) for framing spaced at 48" (1220mm) on center, as described in the current Progressive Engineering, Inc.'s Evaluation Report PER-14076.
   2. Fasteners:
      a. Follow the selected fastener layout for Screw Patterns, for the design Diaphragm Loads as described in the current Progressive Engineering, Inc.'s Evaluation Report PER-14076.
   3. Panel Layout:
      a. Follow the USG Structural Panel Concrete Roof Deck application described in the current Progressive Engineering, Inc.'s Evaluation Report PER-14076.
B. Fire Resistance Ratings: Where fire resistance classifications are indicated, provide materials and application procedures identical to those listed by UL or tested according to ASTM E119 for type of construction shown.
   ***Note**: Fire-resistance ratings may require lighter gauge framing than that required for Shear- or Uniform-Loading. In this case, the gauge and joist depth must be selected by the strongest governing factor.*
C. Noncombustible Ratings: Where noncombustible assemblies are required, provide materials and application procedures identical to those tested according to ASTM E136-12, "Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 °C."
   Note**: Material**s with modified ASTM E136-12 evaluations are not acceptable.

1.06 DELIVERY, STORAGE AND HANDLING

A. Delivery:
   1. Deliver material to site promptly without undue exposure to weather.
   2. Deliver in manufacturer's unopened containers, pallets, or panels fully identified with name, brand, type and grade.
B. Storage:
   1. Store above ground in dry, ventilated space.
   2. Protect materials from soiling, and damage.
      ***Note**: If USG Structural Panels are frozen while stored outdoors, allow to thaw-out naturally. Do not use salts or fertilizers to defrost the panels.*
   3. Panels must be stored over stable soil. Soil must be able to carry the load of the pallets. Each 20 piece pallet weights 3700 lbs (1678 kg).
   4. Pallets must not be stacked over +/- ½" off its edge.

1.09 PROJECT CONDITIONS

A. Environmental Requirements:

1. When mechanically fastened, do not install USG Structural Panel Concrete Roof Deck when ambient or conditioned temperature is below 0 °F (-18 °C).
2. Do not apply finished roofing over USG Structural Panel Concrete Roof Deck when wet, frozen or containing frost.
   Note: *If installed panels have snow or ice, do not use salts or defrosting agents, sand is recommended over slippery surfaces.*

PART 2 – PRODUCTS

2.01 PRODUCTS AND MANUFACTURERS

A. Structural Concrete Panel: Listed products establish standard of quality and are manufactured by United States Gypsum Company (USG), Chicago, IL.

2.02 MATERIALS

A. Structural Concrete Panel **<INSERT DESIGNATION HERE>**:
   1. Basis of Design: Subject to compliance with project requirements, the design is based on the following: USG Corporation, and "USG Structural Panel Concrete Roof Deck".
   2. Classification: A noncombustible concrete roof deck manufactured in accordance with Acceptance Criteria AC318.
   3. Panel Dimensions:
      a. Thickness: 3/4 inch (19 mm)
      b. Width: 4 foot (1220mm)
      c. Lengths: **[**8'-0" (2440 mm)**] or [**6'-0" (1829 mm)**] or [**6'-8" (2032 mm)**]**
      d. Edges: Tongue and Groove.
   4. Panel Properties:
      a. Moment Capacity: 1800 lb-in/ft (685 N-m/m) tested in accordance with ASTM C1185, Sec.5
      b. Bending Stiffness: 315,000 lb-in^2/ft (3kN-m^2/m) tested in accordance with ASTM C1185, Sec.5
      c. Density: 75 lb/ft^3 (1201 kg/m^3) tested in accordance with ASTM C1185
      d. Weight: 5.3 lbs/ft^2 (25.9 kg/m^2) tested in accordance with ASTM D1037 at a thickness of 3/4 inch (19mm)
      e. pH Value: 10 when tested in accordance with ASTM D1293
      f. Noncombustibility: Pass tested in accordance to ASTM E136-12
      g. Surface Burning Characteristics: 0 – Flame Spread / 0 Smoke Developed tested in accordance with ASTM E84
      h. Mold Resistance: 10 tested in accordance with ASTM D3273
         0 tested in accordance with G21

B. Accessories:
   1. USG Structural Panel Concrete Roof Deck Fasteners:
      USG Structural Panel Screw #8 x 1-5/8" (41 mm) with GrabberGard® – Collated
      Item Numbers: CGH8158LG, CHS8158JBWG2
   2. Fastener Properties:
      a. Manufactured in accordance with ASTM C954 and ASTM C 1513

b. Gauge: #8 0.164 inch (4.176 mm) Minimum shank diameter
(do not use a larger size, unless specifically specified by the structural engineer)
c. Length: 1-5/8 inch (41 mm) Minimum
d. Head Type – Thin Wafer
e. Head Diameter - 0.362 inch (9.195 mm) Minimum
f. Corrosion Resistance: Salt Spray >1000-hours when tested in accordance to ASTM B117

3. Fastener System for Concrete Roof Deck to Cold-formed Steel requires:
A low-speed, high-torque drill gun and drive system
a. Fastening Drive: Grabber® SuperDrive® 75 Series with Extension System.

C. Roof Coverings and Roofing Membranes
1. Follow roof covering manufacturers' installation procedures.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates and adjoining construction and conditions under which Work is to be installed. Do not proceed with Work until unsatisfactory conditions are corrected.
1. Steel framing to receive the USG Structural Panel Concrete Roof Deck shall be structurally sound, free from bows, twists or other malformations and in general compliance with local building code requirements. Damaged framing shall be replaced before installation of USG Structural Panel Concrete Roof Deck.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Framing:
1. The roof joists and other roof framing components must be designed to meet the strength and deflection criteria specified in the contract documents. The attachment flange or bearing edge must be a minimum 1-5/8" (41mm) wide. Metal framing must be a minimum 16 gauge.
2. Joist bearing shall be provided at the foundation that is uniform and level.
3. Joists shall be located directly over bearing studs or a header installed at the top of the bearing wall to distribute the load.
4. On steel framing, a web stiffener shall be provided at reaction points and/or concentrated loads as specified in the contract documents. End blocking shall be provided where joists ends are not otherwise restrained from rotation.
5. Additional joists shall be provided under parallel partitions and around all floor openings that interrupt one or more spanning members. Framing must be properly fastened to the supporting walls or structure.
6. All blocking or bridging must be installed prior to the installation of USG Structural Panel Concrete Roof Deck.
7. Framing must be of good quality, free of bows, twists or other malformations.

B. USG Structural Panel Concrete Roof Deck Application:
1. The panels shall be cut to size with a circular saw equipped with carbide-tipped cutting blade and a dry dust collection device or a water-dispensing device that limits the amount of airborne dust. Wear safety glasses and a NIOSH-approved dust mask when cutting the panel. Collected dust shall be disposed in a safe manner and in compliance with local, state and federal ordinances.

2. USG Structural Panel Concrete Roof Deck shall be installed in a horizontal manner (long edges perpendicular to the framing).
3. The fire and structural ratings of the USG Structural Panel Concrete Roof Deck system are based on mechanical attachment only.
4. Begin panel installation by snapping a line across the joists parallel to the rim joist at a distance equal to the width of the first panel being placed. Given that panel width is 48" (1220mm), plan the layout so the first and last panel row width is a minimum of 24" wide. In the case where the row width is less than 24" (610mm) wide, panels shall be blocked on all edges by framing (strapping is not sufficient).
5. Ensure that all supporting members are free of debris before placing panels. Place the cut edge or tongue along the rim joist. Place each panel across three or more supports [minimum two-span condition]. Cut panels to length as needed to ensure that the butt end of the panel is centered on the framing member. Install panels in a direction that ensures that the butt end falls over the open side of the joist. This will help keep adjacent ends in the same place.
6. USG Structural Panel Concrete Roof Deck shall be fastened following the fastening schedule listed in the contract documents. Begin fastening at one end and fan out across the panel. Do not fasten all the corners first. After the installation of one complete row, begin the next row. Slide panels together so that the tongue of the panel being installed fits into the groove of the installed panel. If there is construction debris lodged inside the groove, do not force the tongue into the clogged groove. Clean the plugged groove with a stiff bristle brush to dislodge the trapped debris. Do not gap the panels. "Install the second panel and all subsequent panels in a similar manner to complete the row. Install all rows in a running bond pattern so that end joints fall over the center of the framing members and are staggered by at least two supports from where the end joints fall in the adjacent rows.
7. Cutouts in the panels should be made before installing the panel whenever possible. If a cutout is required after the panel is installed, set the depth of the saw blade to ensure that the framing is not scored. Support the ends and edges of cutouts with framing if they are larger than 6" (153mm) in either direction (refer to SCP14 Installation Guidelines – Treatment of Floor Penetrations).
8. Ensure panel is flush with supporting member, drive fasteners so the heads are flush with the surface of the board. *See Materials §2.02.B of this specification for the correct fastener to be used.*
9. During Construction Traffic Protection – prior to roof finishing, place sheathing materials on the roof in high traffic areas to newly installed USG Structural Panel Concrete Roof Deck (i.e. additional USG Structural Panels or plywood) to protect the newly installed panels.

C. Clean Up:
1. Leftover material shall be removed from the job site.
2. Remove all foreign material from the floor surface and vacuum all dust from the surface.

END OF SECTION

SECTION 06 16 00 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Wall sheathing.
   2. Underlayment.
   3. Sheathing joint and penetration treatment.
   4. Accessories necessary for a complete installation.

1.3 SUBMITTALS

A. Product Data: Technical data for each type of process and factory fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. Include data for fire retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
   3. For fire retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
   4. For products receiving a waterborne treatment, include statement that moisture content of treated materials reduced to levels specified before shipment to Project site.
   5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.4 QUALITY ASSURANCE

A. Fire Test Response Characteristics: For assemblies with fire resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Fire Resistance Ratings: Indicated by design designations from UL *Fire Resistance Directory* or GA-600 *Fire Resistance Design Manual*.

B. Testing Agency Qualifications: For testing agency providing classification marking for fire retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Plywood: DOC PS 1.

B. Oriented Strand Board: DOC PS 2.

C. Thickness: As necessary to comply with requirements specified, but not less than thickness indicated.

D. Factory mark panels to indicate compliance with applicable standard.

2.2 PRESERVATIVE TREATED PLYWOOD:

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.3 FIRE RETARDANT TREATED PLYWOOD

A. Where fire retardant treated materials are indicated, use materials complying with requirements acceptable to authorities having jurisdiction and with fire test response characteristics specified determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire Retardant Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
   1. Use treatment that does not promote corrosion of metal fasteners.
   2. Exterior Type: Treated materials shall comply with requirements specified above for fire retardant treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
   3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high temperature fire retardant treatment is indicated, span ratings for temperatures up to 170 degrees F (76 degrees C) shall be not less than span ratings specified.

C. Kiln dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

D. Identify fire retardant treated plywood with appropriate classification marking of qualified testing agency.

E. Application: Treat plywood indicated on Drawings and the following:
   1. Roof and wall sheathing within 48 inches (1220 mm) of fire walls.
   2. Subflooring and underlayment for raised platforms.

2.4 WALL SHEATHING

A. Glass Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
   1. Product: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation; GlasRoc.
      b. G-P Gypsum Corporation; Dens-Glass Gold.
      c. National Gypsum Company; Gold Bond e(2)XP.
      d. United States Gypsum Co.; Securock.

   2. Type and Thickness: Regular, 1/2 inch (13 mm) hick.
   3. Size: 8 by 96 inches (1219 by 2438 mm) for vertical installation.

2.5 SUBFLOORING AND UNDERLAYMENT

A. Plywood Combination Subfloor Underlayment: DOC PS 1, Exterior, Structural I, C-C Plugged single floor panels.
   1. Span Rating: Not less than 20 o.c.
   2. Nominal Thickness: Not less than 1 inch (25 mm).
   3. Edge Detail: Tongue and groove.
   4. Surface Finish: Fully sanded face.

B. Underlayment: Provide underlayment in nominal thickness not less than 1/4 inch (6.4 mm) over smooth subfloors and not less than 3/8 inch (9.5 mm) over board or uneven subfloors.

C. Sound Deadening Board: Class C fire rated, molded, recycled post-consumer paper, cellulose fiber structural panel.
   1. Density: 26 pcf to 28 pcf (416 = 448 kg/cu.m) tested in accordance with ASTM C209.
   2. Tensile Strength: When tested in accordance with ASTM C209”
      a. Parallel: 450 - 700 psi (3100 - 4,830 kPa).
      b. Transverse: 750 - 1--- psi (5.1171 - 6.894 kPa).

   3. Hardness (Janka Ball): 230 lbs (104 kg) tested in accordance with AST D1037.
   4. Water Absorption by Volume: When tested in accordance with ASTM C209.
      a. 2 Hour Immersion: Maximum 7 percent.

   5. Expansion: 50 percent to 90 percent relative humidity, 0.25 percent in accordance with ASTM C209.
   6. Noise Reduction Coefficient (NCR): 0.20.
   7. Flame Spread: Maximum 75 tested in accordance with ASTM E84 Class C.
   8. Thickness: 3/4 inch (19 mm).

2.6 FASTENERS

A. Provide fasteners of size and type indicated that comply with requirements specified for material and manufacture. Provide fasteners with hot dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening Gypsum Sheathing to Cold Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic polymer or corrosion protective coating having salt spray resistance of more than 800 hours according to ASTM B 117.

1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C 1002.

2.7 SHEATHING JOINT AND PENETRATION TREATMENT MATERIALS

A. Sealant for Glass Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass fiber sheathing tape and for covering exposed fasteners.
   1. Sheathing Tape: Self-adhering glass fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass mat gypsum sheathing and with history of successful in service use.

2.8 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with Table 2304.10.1 Fastening Schedule in ICC *International Building Code*.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall and roof sheathing installation with flashing and joint sealant installation so materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions. Fasten gypsum sheathing to cold formed metal framing with screws. Install boards with a 3/8 inch (9.5 mm) gap where nonload bearing construction abuts structural elements. Install boards with a 1/4 inch (6.4 mm) gap where they abut masonry or similar materials that retains moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
   1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of boards.

D. Seal sheathing joints according to sheathing manufacturer's written instructions. Apply glass fiber sheathing tape to glass mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal penetrations and openings.

END OF SECTION 06 16 00

SECTION 06 20 00 - FINISH CARPENTRY AND MILLWORK

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Providing all finish carpentry items including, but not limited to:
   1. Finish Carpentry.
   2. Millwork and Cabinetry.
   3. Plastic Laminate.
   4. Casework Hardware.
   5. Miscellaneous Millwork.

B. Installation of:
   1. Door hardware.
   2. Plastic laminate faced wood doors.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI A156.9 - Cabinet Hardware
   2. ANSI A161.1 - Woodwork Testing Standards
   3. ANSI A208.1 - Mat-Formed Wood Particleboard.

B. Architectural Woodwork Institute:
   1. AWI - Quality Standards Illustrated.

C. National Electrical Manufacturers Association:
   1. NEMA LD 3 - High Pressure Decorative Laminates.

1.3 PERFORMANCE REQUIREMENTS

A. Unless otherwise indicated, perform work in accordance with AWI “Quality Standards Illustrated”, Custom Grade, except where specification exceeds those standards, the more stringent shall govern.

B. Fabricate millwork and cabinetry in accordance with ANSI A161.1, NEMA LD3, and general static load testing performed and certified by an independent testing agency, covering the following areas of product performance, with these minimum results:
   1. Base cabinet construction/racking test: 800 lbs.
   2. Cabinet front joint loading test: 425 lbs.
   3. Wall cabinet static load test: 2,000 lbs.
   4. Drawer front joint loading test: 600 lbs.
   5. Drawer construction/static load test: 750 lbs.
   6. Cabinet adjustable shelf support device/static load test: 300 lbs.

C. Shelf Loading: Comply with loading/deflection standards of the Composite Panel Association.

1.4 SUBMITTALS

A. Product Data:

1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
2. Manufacturer's preprinted product information for all hardware proposed on the project.
3. Manufacturer's preprinted maintenance instructions for the casework hardware.

B. Shop Drawings:
   1. Indicate size, material and finish.
   2. Show locations and installation procedures, including hardware, sinks, service fixtures, trim and other pertinent data for each unit.

C. Certification: Provide manufacturer's certification that casework has been fabricated and installed according to AWI "Custom" Grade guidelines or better.

D. Samples: Two (2) each, 6 inch by 6 inch by 3/4 inch sample of specified particleboard core with grade stamp for use as verification of installed product.

E. Closeout:
   1. Record Drawings: indicate revisions to original drawings and shop drawings
   2. Manufacturer contact names, addresses and phone numbers.
   3. Finish Material Schedule: names and color numbers of laminates and stains.
   4. Keys: Provide additional master key for each room and additional locksets totaling one percent of total project for attic stock.

1.5 QUALITY ASSURANCE

A. Manufacturer: Minimum of five (5) years experience in providing manufactured casework systems for similar types of projects, produce evidence of financial stability, bonding capacity, and adequate facilities and personnel required to perform on this project.

B. Delivery conference: 48 hours prior to delivery, notify Architect of delivery date and time. At the Architect's discretion, a representative of the Architect may be present at the time of delivery. Casework not conforming to the specified requirements, as reasonably determined by the Architect's representative, shall be removed and returned to manufacturer for repair or replacement at no additional cost to the Owner or increase in time.

1.6 PRE-INSTALLATION CONFERENCE

A. Section 01 31 00 – Project Management and Coordination.

1.7 PRODUCT HANDLING

A. Deliver completed laminate clad casework, countertops and related products only after wet operations in building are completed. Store in ventilated place, protected from the weather, with relative humidity range of 20 to 50 percent.

B. Protect finished surfaces from soiling and damage during handling and installation with a protective covering.

1.8 JOB CONDITIONS

A. Environmental Requirements: do not install casework until permanent HVAC systems are operating and temperature and humidity have been stabilized for at least one (1) week.
   1. Manufacturer/Supplier shall advise Contractor of temperature and humidity requirements for architectural casework installation areas.
   2. After installation, control temperature and humidity to maintain relative humidity between 25 and 55 percent.

B. Conditions: Do not store or install casework in building until concrete, masonry, and drywall/plaster work is dry.

1.9 COORDINATION

A. Coordinate the Work of this Section with plumbing work specified in Division 15. Coordinate sink opening construction with sinks specified in Division 15.

B. Coordinate location of blocking in walls for installation and support of wall cabinets.

1.10 WARRANTY

A. Warranty the work specified herein for five (5) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

B. Defects shall include, but not be limited to the following:
   1. Rough or difficult operation, or loose or missing parts.
   2. Delamination of surfaces.
   3. Noticeable deterioration of finish.
   4. Warped or misaligned surfaces or telegraphing of subsurface imperfections.

PART 2 - PRODUCTS

2.1 MILLWORK MANUFACTURERS

A. Manufacturers listed below are certified by AWI Quality Certification Program and are listed for the Contractor's convenience only and shall not preclude the Contractor from using other manufacturers, provided they produce equivalent products of the type specified for the scope and size of the Project. Other manufacturers must have experience manufacturing products meeting or exceeding the specifications and must comply with the criteria specified in paragraph 1.6 above and with Division 1 requirements regarding substitutions.
   1. Casework:
      a. Ameritek Design Inc.; (281) 442-7767.
      b. Calmar Manufacturing Co., Inc.; (563)562-3261.
      c. Case Systems, Inc.; (989) 496-9510.
      d. Global Casework Manufacturing, Inc.; (281) 494-6181.
      e. Imperial Mill & Fixture, Inc.; (361) 883-4630.
      f. Jericho Woodworks; (281) 969-7947.
      g. Jim R. Reynolds & Associates, Inc.; (281) 350-1133.
      h. LSI Corporation of America, Inc.; (763) 559-4664.
      i. MGC Millwork, LP; (713) 772-0894.
      j. South Texas Woodmill, Inc.; (956) 831-3304.
      k. Stevens Industries, Inc.; (217) 540-3100.
      l. Terrill Manufacturing Co.; (915) 655-7133.
      m. TMI Systems Design Corp.; (701) 225-6716.
      n. Victoria Cabinetworks; (361) 578-0263.
      o. Alpha Omega Casework LLC; (512) 365-1776.

2.2 MILLWORK MATERIALS

A. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD3, and the following requirements:
   1. Exterior Color Selection Available:

a. Architect to select from minimum of 250 selections available, including wood grain patterns and solid colors.
b. Provide 5 different colors available per project.
c. If laminate has wood grain, direction of grain shall be vertical on door, end panels, fascia panels, and exposed backs; horizontal on drawer faces, aprons, and top rails.

2. Laminate grades:
   a. Exposed doors, finished end panels, and other vertical surfaces: GP28 (0.028 inch thick nominal)
   b. Horizontal surfaces other than top: GP28 (0.028 inch thick nominal)
   c. Cabinet Liner: CL20 (0.020 inch nominal), white.
   d. Work Surfaces and Countertops: GP50 (0.050 inch thick nominal) with BK20 (0.20 inch thick) backer sheet.
   e. Backsplash: PH42 (0.042 inch nominal) with nominally balanced backer sheet.

3. Adhesive: PVA water resistant adhesive. Contact adhesives not permitted.
4. Pressure Fused Laminate:
   a. NEMA LD3 VGL, and NEMA LD3 CLS, Melamine resin impregnated, 120 gram PSM minimum, thermofused to core under pressure.
   b. Color:
      1) Closed interiors, underside of wall cabinets: White.
      2) Exposed and Semi-exposed open cabinets: Match exterior.

   c. Provide balanced construction with same thermofused melamine. Unsurfaced coreboard or simple backers not allowed.

B. Core Material:
1. Particleboard: ANSI 208.1, minimum 45 pcf density, Grade M-3.
2. Plywood: Shop sanded, exterior grade veneer cored, hardwood faced, any species, with no defects affecting strength or utility. Overlay plywood not permitted. Plywood allowed at countertops and toe-base only.
3. Water resistant treated plywood: shall have 24 hour thickness swell factor of five percent or less and 24 hour water absorption factor of ten percent or less; P.S. 51, Type II or better.
4. Cabinet components shall be of the following minimum core thicknesses:
   a. Cabinet backs, drawer body, and drawer bottoms: 1/2 inch particleboard
   b. Door and drawer face, base, wall, and tall cabinet tops and bottoms, cabinet sides, drawer spreaders, cabinet back rear hangstrips, structural dividers, and exposed cabinet backs: 3/4 inch particleboard
   c. Work surfaces and countertops: minimum 1 inch particleboard or plywood, except use water resistant treated plywood core at counters with sinks.
   d. Shelves: 3/4 inch particleboard core for 30 inches long or less, 1 inch thick particleboard core for more than 30 inches long; 14 inch deep, unless otherwise noted. Provide vertical dividers for shelves over 36 inches long.
   e. Cabinet Toe-Base: 3/4 inch plywood. No particleboard within four (4) inches of floor.

C. Countertops and Backsplashes:
1. Countertops: Provide countertops with PVC edge in as long as practical continuous lengths. Provide field glued splines at joints. No joints closer than 24 inches either side of sink cutout.
2. Backsplash: Integral to countertop, 4 inch high unless otherwise shown. Fabricate with single continuous sheet of laminate from front counter to top of splash with no joints from horizontal to vertical application. No joints shall occur at sink openings.
3. At exposed countertop end corners, provide 1 inch radius, or similar safety treatment.

D. Toe Spaces: Leave toe spaces unfinished for installation of resilient base, unless otherwise shown.

E. End Panels and Filler Strips: Match adjacent case-piece.

F. Edging:
1. Provide the following in accordance with “Edging Locations”:
a. Flat Edge PVC: 0.020 inch. Solid, high-impact, purified, color-thru, acid resistant, machine-applied with hot melt adhesives.
b. 3 mm PVC: Solid, high-impact, purified, color-thru, acid resistant, pre-lamination primed edging, machine-applied with hot melt adhesives, and machine profiled to 1/8 inch radius.

2. Edging Locations:
a. Cabinet body edge, including door/drawer front spacer rail: Flat Edge PVC, color matched to door/drawer face or as selected.
b. Forward edge of interior body components, interior dividers, shelf, and top edges of drawer body: Flat Edge PVC to match cabinet interior surface color.
c. Door/Drawer-Front edging: 3mm PVC, color matched to standard laminates.

2.3 CABINET HARDWARE

A. All hardware shall meet ANSI A156.9 and shall be subject to approval by the Architect. All keying shall match existing master key system and be approved by the Owner.
1. Acceptable Manufacturers:
a. Accuride
b. National
c. Knape & Vogt
d. Ives
e. Stanley
f. As specified herein, provide specified product, or Architect approved equal.

B. Hinges:
1. Heavy duty, five-knuckle 2 3/4 inch institutional type hinge shall meet ANSI/BHMA A156.9 Grade 1 requirements. Mill ground, hospital tip, Teflon coated tight pin feature with all edges eased. Hinge shall be full wrap around type of tempered steel 0.095 inch thick. Each hinge shall have minimum of 9 screws, #7, 5/8 inch FHMS to assure positive door attachment.
2. One pair per door to 48 inch height. One and one-half pair over 48 inches in height. Hinge shall accommodate 13/16 thick laminated door and allow 270 degree swing.
3. Finish: US26D.

C. Pulls:
1. Wire design, 4 inches, Chrome, US26D finish.

D. Sliding Door Hardware:
1. Frameless 1/4 inch glass sliding doors: double track rolling door assembly.
2. Framed 13/16 inch thick stile and rail sliding doors: top mounted track with dual roller hangers. Vertical adjustment for accurate alignment.

E. Drawer Slides:

1. Standard Drawers: 3/4 extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 100 pound dynamic load rating at full extension.
2. File Drawers: Full extension, 3-part progressive opening slide, precision steel ball bearing, minimum 100 pound dynamic load rating at full extension, zinc plated or epoxy coated at manufacturer's option.
3. Provide body mounted molded rails for hanging file system for legal or letter size as indicated by manufacturer's model number. Cutting or machining of drawer body/face not permitted.
4. Paper Storage Drawers: Full extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 150 pound dynamic load rating at full extension.

F. Catches: Provide opening resistance in compliance with the Americans with Disabilities Act.
1. Provide top-mounted magnetic catch for base and wall cabinet door.
2. Provide two at each tall cabinet door. Catch housing shall be molded in White.

G. Adjustable Shelf Supports:
1. Dual-pin design with anti tip-up shelf restraints for both 3/4 inch and 1 inch shelves.
2. Include keel to retard shelf slide-off, and slot for mechanical attachment of shelf to clip.
3. Load rating shall be minimum 300 pounds each support without failure.

H. Wardrobe Rod: 1-1/6 inch diameter plated steel rod, with captive sockets.

I. Coat Hooks: Single and double prong, wall mount - Satin Aluminum.

J. Locks: Five-disk tumbler cam-style with strike. Locks on cabinets in same room keyed alike. Provide two (2) keys per room where doors and drawers are scheduled to receive locks. Dull chrome finish. Lock core shall be removable with a control key, permitting Owner to change lock arrangements without tools.

2.4 SPECIALTY ITEMS

A. Grommets:
1. Size: 2-1/2 inches diameter with "Flip-Top"™ tab in cap.
2. Colors: As selected by Architect from manufacturer's available colors.
3. Number/Location: Where electrical, telephone, and computer data wiring need to pass through tops whether shown or not.
4. Approved Product/Manufacturer: Model No. EDP3 manufactured by Doug Mockett & Company, Inc., Manhattan Beach, CA; (800) 523-1269, or Architect approved equal.

B. Keyboard Drawers (At all knee spaces):
1. Approved Product/Manufacturer: No. SD-1 as manufactured by Knape & Vogt; or Architect approved equal.

C. Molded Personal Pencil Drawer: High-impact 100 Polystyrene with in-stop, out-stop, and self-closing features. Provide under top mounted 100 lb self-closing slides. Twelve compartment drawer body, and slides, Black. Provide where indicated on plans.

D. Mailbox Label Holder: Brass, card size 1/2" x 2-3/16". Provide one (1) at each opening.

2.5 SOLID STOCK

A. Moisture Content: Percent of moisture in relation to over-dry weight shall be between 8 percent and 13 percent at time of installation.

B. Paint Grade Hardwood: Any species, including Parana Pine, except do not use Oak, Elm or similar species which have coarse grain.

2.6 MISCELLANEOUS

A. Utility Shelving: AWI "Economy" grade.

B. Telephone/MDF/IDF Board: Provide minimum 4 foot by 8 foot by ¾ inch thick plywood for telephone/data punch down blocks and video equipment in accordance with Section 06 10 00, Rough Carpentry. Paint in accordance with Section 09 91 00, Painting.

2.9 MILLWORK FABRICATION

A. Fabricate casework, countertops and related products to dimensions, profiles and details shown on drawings. Fabricate casework square, plumb, and true.

B. Detailed Requirements For Cabinet Construction:
   1. Toe-Base:
      a. Continuous, ladder type platform with concealed fastening to cabinet bottom, level and secured to floor
      b. Toe-base at exposed cabinet end panels shall be recessed 1/4 inch from face of finished end, for flush installation of finished base material.
      c. No cabinet sides-to-floor will be allowed.

   2. Cabinet Top and Bottom:
      a. Solid sub-top shall be furnished for all base and tall cabinets.
      b. At cabinets over 36 inches bottoms and tops shall be mechanically joined by a fixed divider.
      c. Assembly devices shall be concealed on bottom side of wall cabinets.

   3. Cabinet Sides:
      a. Doweled, and glued under pressure, or attached with fully concealed interlocking mechanical fasteners to sub-top and bottom.
      b. Drill holes for adjustable shelves 1-1/4 inches on center.

   4. Cabinet Backs:
      a. Side bound, captured in grooves, recessed from cabinet rear, and securely fastened at top and bottom.
      b. Hang rails shall be located at rear of cabinet back and fastened to cabinet sides. Provide minimum of two (2) at base, two (2) at wall, and three (3) at tall cabinets as instructed by casework manufacturer.
      c. Provide removable back panels and closure panels for plumbing access at all sink cabinets, and where shown on drawings.

   5. Exposed end corner and face frame attachment:
      a. Butt joint, glued and finish nailed; or attached with fully concealed interlocked mechanical fasteners.
   6. Door and Drawer Fronts:
      a. Drawer fronts and hinged doors shall overlay the cabinet body. Maintain a maximum 1/8 inch reveal between pairs of doors, between door and drawer front, or between multiple drawer fronts within the cabinet.

b. Where indicated, provide Stile and Rail doors with full 1/4 inch plate glass, hinged or sliding. Exposed lite-opening edges shall be trimmed and glazed with extruded glazing bead.
c. Where indicated, frameless sliding glass doors shall be 1/4 inch thick plate glass with ground and polished edges. Fit with anodized aluminum shoes and nylon rollers.

C. Drawers:
1. Drawer fronts: apply to separate drawer body component sub-front.
2. Drawer sides: doweled to receive front and back, glued under pressure, machine squared.
3. Drawer bottom: set into front and sides, 1/4 inch deep groove with minimum 3/8 inch standing shoulder, continuously glued. Reinforce drawer bottoms with 1/2 inch by 4 inch front-to-back intermediate underbody stiffeners, mechanically fastened. One at 24 inches, two at 36 inches, and over.
4. Paper storage drawers: fitted with full width hood at back.
5. Hanging file drawers shall be fabricated to accept letter size hanging folders compatible with Pendaflex system.

D. Vertical and Horizontal Dividers: As required by manufacturer for type and style of component.

E. Door/Drawer Front Rail: As required by manufacturer for type and style of component, and hardware placement.

F. ADA, Americans with Disabilities Act Requirements: The following special requirements shall be met, where specifically indicated on architectural plans as “ADA”, or by General Note. Shall be in compliance with Federal Register Volume 56, No. 144, Rules and Regulations:
1. Countertop height: With or without cabinet below, not to exceed a height of 34 inches Above Finished Floor (A.F.F.), at a surface depth of 24 inches
2. Kneespace clearance: minimum 29 inches A.F.F. at apron, and 30 inches clear span width.
3. 12 inch deep shelving, adjustable or fixed: Not to exceed a range from 9 inches A.F.F. to 54 inches A.F.F.
4. Wardrobe cabinets: Provide with rod/shelf adjustable to 48 inches A.F.F. at a maximum 21 inch shelf depth.
5. Sink cabinet clearances: In addition to above, upper kneespace frontal depth shall be no less than 8 inches, and lower toe frontal depth shall be no less than 11 inches, at a point 9 inches A.F.F., and as further described in Volume 56, Section 4.19.

G. Typical Desk or Counter Height at Kneespace Locations: 30” above finished floor.

PART 3 - EXECUTION

3.1 MILLWORK INSTALLATION

A. Positioning: Place approximately level, plumb and at right angles to adjacent work.

B. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging the products and adjacent work.

C. Anchorage: Attach securely so the products will perform to their maximum ability without damage from inadequate fastenings.

D. Fasten tops to frames with concealed clips, screws and glue.

E. Install simulated wood trim in locations shown on drawings and in accordance with manufacturer's instructions.

3.2 EXISTING DOOR LAMINATE RESURFACING

A. Resurfacing procedures shall be in accordance with the recommendations and instructions of the laminate and adhesive manufacturers.

B. Acclimate laminate to the same environment as existing material at least 48 hours. Perform work in well ventilated area, out of the way of construction dust and traffic to maintain clean adhesion.

C. Clean the substrate with detergent or non-flammable solvent as instructed by laminate manufacturer to remove wax, grease, and polish deposits.

D. Using a belt sander or sander instructed by manufacturer, sand entire surface to remove original finish. Remove sanding dust thoroughly.

E. Coat the sanded surface and back of laminate with a uniform coating of contact adhesive. Allow to dry thoroughly prior to assembling. Assembling wet adhesive lines will trap solvent and may result in poor bonding. Follow the adhesive manufacturer's instructions.

F. Index the laminate with the substrate. Make initial contact by smoothing with palms. Apply pressure using a "J" roller or rotary press. Allow to set as instructed by adhesive manufacturer to achieve full adhesion to maintain warranty. Trim with recommended tools.

G. Apply laminate to door faces, and exposed vertical edges. Apply edges before face. Paint top and bottom edges to color match facing.

H. Coordinate hardware and vision lite cutouts with work of other sections.

3.3 FINISH HARDWARE INSTALLATION

A. The supplier will mark each item of hardware for location. Protect the markings until each item is installed. If any item is delivered to the job not properly marked, return it to the supplier for marking before attempting to install it.

B. Check markings on hardware for proper location. Install and make necessary adjustments for proper working order. Any hardware damaged by improper adjustment or careless abuse will be replaced by the Contractor at his expense.

C. Provide clean, properly sized and accurately placed mortises and drilled holes for all mortise hardware such as locksets and for cylindrical locks where specified only.

D. Fit all surface-applied hardware accurately.

E. After hardware is installed, protect exposed surfaces by use of heavy paper and masking tape and maintain until job completion.

F. Remove all finish hardware except that which is primed for painting before painter's finish is applied. Permanently replace and re-adjust for proper function after painter's finish has dried hard.

G. Millwork contractor shall be responsible for hardware on millwork.

3.4 PLASTIC LAMINATE FACED WOOD DOOR INSTALLATION

A. Protect all doors during handling.

B. Refer to Section 08 71 00, Door Hardware for hardware requirements.

C. Install doors in accordance with manufacturer's instructions.

D. Install and adjust doors for smooth, quite operation.

END OF SECTION 06 20 00

SECTION 06 73 00 - COMPOSITE DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Deck.
   2. Accessibility ramp and railing.
   3. Bench.
   4. Framing and supports.
   5. Accessories necessary for a complete installation.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance:
   1. Uniform Load, Deck: 100lbf/sq.ft.

1.4 SUBMITTALS

A. Product Data: Technical data and installation recommendations for plastic decking and metal framing anchors.

B. Samples: Submit samples not less than 24 inches (600 mm) long showing the range of variation anticipated in appearance of decking, including surface texture.

C. Design Calculations: Submit design calculations prepared by the licensed engineer based on deck design loads and spans.

D. Evaluation Reports: For the following, from ICC-ES:
   1. Plastic deck planks.
   2. Expansion anchors.
   3. Metal framing anchors.
   4. Deck fasteners.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Building Code: Comply with applicable provision of the IBC with local amendments for exterior plastic materials and components and structural loading for decks.
   2. Surface Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      a. Flame Spread Index: 25 or less.
      b. Smoke Developed Index: 450 or less.

A. Plastic Lumber: Products complying with applicable Code provisions for indicated type of construction. Allowable loads and spans as documented in evaluation reports or in information referenced in evaluation reports shall not be less than design loads and spans indicated.

B. Source Limitations: Obtain access-flooring system from single source from single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials under cover and protected from weather and contact with damp or wet surfaces. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

B. Handle and store plastic lumber to comply with manufacturer's written instructions.

1.7 WARRANTY

A. Commercial Warranty: Written warranty signed by manufacturer warranting against rot, decay, splitting, checking, splintering, fungal damage, and termite damage.
   1. Materials and Installation Warranty Period: 10 years from the date of substantial completion.

B. Fade and Stain Warranty: Written warranty signed by manufacturer in which manufacturer warrants against food staining and fading beyond 5 Delta E (CIE units).
   1. Fade and Stain Warranty Period: 10 years from the date of substantial completion.

PART 2 - PRODUCTS

2.1 PLASTIC DECK

A. Basis of Design: Trex Company Transcend series. Subject to compliance with requirements, provide products by one of the following:
   1. TimberTech.
   2. Trex Company, Inc.
   3. Weyerhaeuser Company.

B. Composite Plastic Lumber: Solid shapes made from a mixture of low density polyethylene and recycled wood.
   1. Deck Standard: ICC-ES AC109, ICC-ES AC174, or ICC-ESR 3168.
   2. Deck Board Size: 7/8 inch by 6 inches by 12 inches (22 mm by 150 mm by 300 mm) and 1 inch by 6 inch by 12 inches (25 mm by 150 mm by 300 mm).
   3. Strength: Deck boards of strength to resist concentrated load of 300 lbf (1.33 kN) when installed at maximum center to center space complying with maximum 12 inch (300 mm) maximum span.
   4. Configuration: Grooved edges designed for fastening with concealed decking fasteners.
   5. Surface Texture: Woodgrain.
   6. Color: Selected by Architect.

C. Deck Framing: Same composite board lumber as deck floor, with structural capabilities complying with requirements.

D. Fasteners: Fasteners of size and type indicated, acceptable to AHJ, comply with requirements. Provide stainless steel nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into substrate.
   1. Nails: ASTM F 1667.
   2. Power Driven Fasteners: ICC-ES AC70.
   3. Wood Screws and Lag Screws: ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.
   4. Stainless Steel Bolts: ASTM F 593, Alloy Group 1 or 2 (ASTM F 738M, Grade A1 or Grade A4); with ASTM F 594, Alloy Group 1 or 2 (ASTM F 836M, Grade A1 or Grade A4) hex nuts and, where indicated, flat washers.
   5. Postinstalled Anchors: Stainless steel, torque controlled expansion anchors with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when

installed in concrete as determined by testing according to ASTM E 488 conducted by a qualified independent testing and inspecting agency.

a. Stainless steel bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or Grade A4).

E. Metal Framing Anchors:

1. Allowable Design Loads: Provide products with allowable design loads published by manufacturer that meet or exceed those indicated on Drawings. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
2. Stainless Steel Sheet: ASTM A 666, Type 304.
3. Joist Hangers: U shaped, with 2 inch (50 mm) long seat and 1-1/4 inch (32 mm) wide nailing flanges at least 85 percent of joist depth.
   a. Thickness: 0.062 inch (1.6 mm).
4. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.
   a. Width: [1-1/4 inches (32 mm).
   b. Thickness: 0.062 inch (1.6 mm).
   c. Length: Recommended by manufacturer.

F. Concealed Decking Fasteners:

1. Deck Splines: Corrosion resistant metal that fit in grooves routed into the sides of decking material and are fastened to deck framing with screws. Splines provide uniform spacing of decking material.
2. Deck Clips: Black oxide coated, stainless steel clips designed to be fastened to deck framing with screws, and to secure decking material with teeth that also provide uniform spacing of decking material.
3. Deck Tracks: Formed metal strips designed to be fastened to deck framing and to secure decking material from underside with screws. Made from epoxy powder coated, hot dip galvanized steel or stainless steel.

G. Access Ramp: Access ramp units, slope indicated but not steeper than 1:12 to comply with requirements of Texas Accessibility Standard, of the same construction as composite wood decl. Equip ramp with handrails and permanently attach ramp to deck to prevent movement or separation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the work. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION

A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit work to other construction; scribe and cope as needed for accurate fit.

B. Framing Standard: Comply with AF&PA WCD1 unless otherwise indicated.

C. Install plastic lumber to comply with manufacturer's written instructions. Secure decking to framing with deck clips or screws.
   1. Install metal framing anchors to comply with manufacturer's written instructions.
   2. Do not splice structural members between supports unless otherwise indicated.
   3. Provide blocking and framing as necessary to support facing materials, fixtures, specialty items, and trim.

D. Securely attach deck framing to substrate by anchoring and fastening using fasteners recommended by manufacturer. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced and with adjacent rows staggered.

E. Ramp: Securely attach ramp to deck framing.

F. Railings: Secure railing to ramp in accordance with accessibility regulations.

END OF SECTION 06 73 00

SECTION 07 13 00 - SHOWER STALL WATERPROOFING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Shower stall waterproofing installed at floors of all showers.

1.3 DEFINITIONS

A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 REFERENCES

A. ASTM International (ASTM)
   1. D4068, Standard Specification for Chlorinated Polyethylene (CPE) Sheeting for Concealed Water-Containment Membrane

1.5 RESPONSIBILITY OF COORDINATION

A. Coordinate the work specified with the following work:
   1. Concrete work
   2. Plumbing work
   3. Gypsum wallboard work

1.6 SUBMITTALS

A. Product Data: Submit literature and illustrations to indicate the performance and fabrication procedures.

B. Samples: Submit 12 inch by 12 inch samples for final approval.

1.7 DELIVERY AND STORAGE

A. Delivery: Deliver clearly labeled, undamaged materials in the manufacturer's unopened containers.

B. Timing and Coordination: Deliver materials to allow for minimum storage time at the project site. Coordinate delivery with the scheduled time of installation.

C. Storage: Store materials in a clean, dry location, protected from weather and abuse.

1.8 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 00 – Project Management and Coordination.

1.9 WARRANTY

A. Warrant the work specified herein for the life of the original installation against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

B. Defects shall include, but not be limited to, the following:
   1. Deterioration
   2. Leaking
   3. Releasing from substrate

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufactures listed whose products meet or exceed the specifications are approved for use on the project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
   1. Chloraloy 240 CPE Shower Pan Liner manufactured by The Noble Company; (800) 878-5788 or comparable product.

2.2 MATERIALS

A. Shower Pan:
   1. Type: Chlorinated polyethylene (CPE) waterproofing/cleavage membrane for full mortar bed ceramic tile installations at shower pans and shower floor waterproofing and drain systems.
   2. Thickness: 0.040 inch nominal.
   3. Weight: Approximately 60 lbs. per roll.
   4. Coverage: 200 square feet per roll.
   5. Roll Sizes: 60 inches wide x 40 feet long and 48 inches wide x 50 feet long.

B. Adhesive and Accessories: Type recommended by manufacturer to suit application.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locations: Install membrane in accordance with manufacturer's instructions under shower stall floors and around perimeter of shower area, up walls and over curbs, where indicated.

B. Coordinate work with Section 03 30 00, Cast-In-Place Concrete and Section 09 21 16, Gypsum Wallboard Systems.

C. Adjacent work: Protect work by masking, covering, or other precautionary methods. Remove protection when no longer necessary.

D. Lengths: Install membrane with minimum number of joints within the shower floor. If membrane is not available in a single width, join by lapping membrane minimum two (2) inches and seal joint throughout its length in accordance with manufacturer's instructions.

E. Penetrations: Where drain penetrates membrane, make opening snug and seal in accordance with manufacturer's instructions.

END OF SECTION 07 13 00

SECTION 07 16 00 - BELOW GRADE WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Preparation of concrete surfaces to receive waterproofing membrane.

B. Sealing of cracks and joints.

C. Fluid applied waterproofing system, with prefabricated drainage composite or protection board at elevator pit walls and at Auditorium walls that fall below grade.

D. Pre-applied waterproofing system, with joint sealing tape, and other accessories at below grade horizontal surfaces under the slab or elevator pit.

1.3 SUBMITTALS

A. Product Data:
   1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
   2. Manufacturer's installation instructions.

B. Certifications:
   1. Manufacturer’s certification that applicator is approved by manufacturer.
   2. Manufacturer’s affidavit that materials used in Project contain no asbestos.

C. Warranty: Submit a sample warranty identifying the terms and conditions stated in warranty.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: Applicator shall be experienced in applying the same or similar materials and shall be specifically approved in writing by the membrane system manufacturer.

B. Regulatory Requirements: Comply with applicable codes, regulations, ordinances, and laws regarding use and application of products that contain volatile organic compounds (VOC).

1.5 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 13 – Project Management and Coordination.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials job site in original, factory-sealed, unopened containers bearing manufacturer's name and label intact and legible with following information.
   1. Name of material.
   2. Manufacturer's stock number and date of manufacture.
   3. Material safety data sheet (MSDS).

B. Store and handle in strict compliance with manufacturer's instructions, recommendations and material safety data sheet (MSDS).

C. Protect from damage from sunlight, weather, excessive temperatures and construction operations.

D. Remove damaged material from the site and dispose of in accordance with applicable regulations.

E. Do not double-stack pallets of waterproofing on the job site. Provide cover on top and all sides.

F. Store drainage composite and protection board flat and off the ground. Provide cover on top and all sides.

G. Protect waterproofing materials from freezing. In cool temperatures, store the material for several hours at room temperature to facilitate mixing and application.

H. Sequence deliveries of materials to avoid delays, but minimize on-site storage.

1.7 PROJECT CONDITIONS

A. Perform Work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used.

B. Proceed with installation only when substrate construction and preparation work is complete and in condition to receive membrane waterproofing.

C. Coordinate waterproofing Work with other trades to ensure adequate illumination, ventilation, and dust-free environment during application and curing of membrane. The applicator shall have sole right of access to the specified areas for the time needed to complete the application and allow the membrane to cure adequately.

D. Protect adjoining surfaces not to be coated against damage or soiling. Protect plants, vegetation and animals which might be affected by waterproofing operations.

E. Warn personnel against breathing of vapors and contact of material with skin or eyes. Wear applicable protective clothing and respiratory protection gear.

F. Keep products away from spark or flame. Do not allow the use of spark producing equipment during application and until all vapors have dissipated. Post "NO SMOKING" signs.

G. Maintain work area in a neat and orderly condition, removing empty containers, rags, and rubbish daily from the site.

1.8 WARRANTY

A. Warrant the Work specified herein for two (2) years against becoming unserviceable or causing an objectionable appearance resulting from both defective or non-conforming materials and workmanship.

PART 2 - PRODUCTS

2.1 FLUID APPLIED WATERPROOFING SYSTEM

A. Specifications are based on named manufacturer. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
1. Carlisle Coatings and Waterproofing Incorporated, Sapulpa, OK (Barricoat).
2. Grace Construction Products, W. R. Grace & Co.-Conn., Austin, TX.

B. Waterproofing Membrane: Two (2) part, self-curing, synthetic rubber based material meeting or exceeding the performance requirements of ASTM C836 and other ASTM standards as indicated in the following table and conforming to W.R. Grace & Co. “Procor” waterproofing membrane.

Waterproofing Membrane Physical Properties, minimum:

Property	Test Method	Typical Value
Cured Film Thickness	ASTM D3767 Method A	1.5 mm (0.60 in.) nom
Solids Content	ASTM D1644	100 percent
Flexibility, 180 degree	ASTM D1970	Unaffected
Bend over 25 mm (1 in.)		
Mandrel at 32 degrees C (-25 degrees F)		
Elongation	ASTM D412	500 percent minimum
Peel Adhesion to Concrete	ASTM D903 Modified*	880 N/m (5 lbs./in.)

C. Accessory Products:
1. Prefabricated Drainage Composite: Shall be designed to promote positive drainage while serving as a protection course.
   a. Hydroduct ® 660 Drainage Composite for use on all horizontal surfaces.
   b. Hydroduct ® 220 Drainage Composite for use on all vertical surfaces.

2. Protection Board (Use only where prefabricated drainage composite is not used):
   a. Asphalt Hardboard: A pre-molded semi-rigid protection board consisting of bitumen, mineral core and reinforcement. Provide 3 mm (0.125 inch) thick hardboard on horizontal surfaces not receiving steel reinforced slab. Where steel reinforcing bars are to be used, apply two (2) layers of 3 mm (0.125 inch) thick hardboard or one (1) layer of 6 mm (0.25 inch) thick hardboard.
   b. Expanded Polystyrene: 25 mm (1 inch) thick for vertical applications with the following characteristics:
      1. Normal Density: 1.0 pcf^3
      2. Thermal Conductivity, K factor: 0.24 at 40 degrees F, 0.26 at 24.
      3. 75 degrees F.
      4. Thermal Resistance, R-Value: 4 per 1 inch of thickness.

D. Locations: Vertical below-grade retaining walls and walls that fall below grade 0’-0” and where shown on drawings.

2.2 PRE-APPLIED WATERPROOFING SYSTEM

A. Specifications are based on named manufacturer. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
1. Carlisle Coatings and Waterproofing Incorporated, Sapulpa, OK.

2. Grace Construction Products, W. R. Grace & Co.-Conn., Austin, TX.

B. Waterproofing Membrane: Composite sheet comprising a thick HDPE film, an aggressive pressure sensitive adhesive and a weather resistant protective coating. Membrane provides a continuous seal that resists water ingress and migration between the membrane and the structure. The waterproofing system shall conform to the following products as manufactured by W.R. Grace & Co.:
1. Membrane: Robust membrane for horizontal use below concrete slabs complying with Preprufe 200.
2. Tape: Self-adhesive 8 inch wide strip applied to the surface of the membrane along the line of all concrete joints (application temperature range minus 25 degrees F to 86 degrees F. Product shall conform to Preprufe CJ Tape LT; or in hot climates (minimum 50 degrees F), use Preprufe CJ Tape HC.
3. Sealing Membrane: For sealing around penetrations shall conform with Bituthene.

C. Locations: Below grade horizontal surfaces under the slab, and where shown on drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before waterproofing work is started the all surfaces to be waterproofed shall be thoroughly examined for all deficiencies. Should deficiencies exist, the Architect shall be notified in writing and corrections made.

3.2 SURFACE PREPARATION

A. Surfaces to which waterproofing is to be applied shall be thoroughly clean, dry and free from all surface contaminates or cleaning residue that may harmfully affect the adhesion of the membrane.

B. Repair all cracks in accordance with manufacturer’s instructions.

3.3 APPLICATION

A. Priming: Shall be in accordance with membrane manufacturer's instructions.

B. Apply waterproofing in accordance with membrane manufacturer's instructions.

C. Liquid membrane waterproofing on vertical walls shall positively overlap turned up sheet membrane waterproofing from under slab as instructed by the manufacturer.

D. Where shown or required, install specified perimeter drainage system as the first course of drainage composite immediately after membrane has cured on vertical surfaces. Install manufacturer’s recommended drainage composite or protection board/protection course on remainder.

END OF SECTION 07 16 00

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Extruded polystrene foam board
   2. Thermal insulation.
   3. Accessories necessary for a complete installation.

1.3 DEFINITIONS

A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 RELATED SECTIONS

A. Section 04 20 00 - Unit Masonry.

B. Section 07 84 00 – Firestopping.

C. Section 09 21 16 - Gypsum Board Assemblies.

D. Section 09 51 00 - Acoustical Ceiling Panels.

E. Division 23 – Mechanical: Duct Insulation.

1.5 SUBMITTALS

A. Product Data: Technical data and installation instructions for each type of insulation product specified.

B. Samples: Six (6) inch x six (6) inch piece of rigid insulation for Architect’s approval.

C. Certifications:
   1. Manufacturer’s certification of compatibility of rigid insulation with dampproofing mastic.
   2. Manufacturers affidavit that materials used in Project contain no asbestos.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Fire Performance Characteristics: Identify products with appropriate markings of applicable testing and inspecting organization.
      a. Surface Burning Characteristic: ASTM E 84.
         1) Flame Spread Index: Maximum 25.
         2) Smoke Developed Index: Maximum 450.

b. Fire Resistance Ratings: ASTM E 119.
c. Combustion Characteristics: ASTM E 136.

2. National Fire Prevention Association (NFPA) 255 Test of Surface Burning Characteristics of Building Materials.
3. Underwriter's Laboratories (UL) 723 Tests for Surface Burning Characteristics of Building Materials.

B. Cellulose Insulation Manufacturer: Manufacturer having minimum 5 years documented experience and ISO 9002 Certified.
1. Manufacturer shall provide independent laboratory follow up inspection services of Underwriters Laboratory and Factory Mutual. Label each bag accordingly.

C. Cellulose Insulation Applicator: Applicator having minimum 5 years documented experience and licensed by manufacturer.

D. Single Source Responsibility for Insulation Products: Obtain each type of building insulation from single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of Work.

E. Environmental Requirements: Manufacture extruded polystyrene with HCFC or other CFC free blowing agents. Mark insulation boards and packages with manufacturer's name and product designation. Unmarked boards and packages will be rejected.
1. Wherever possible, provide boards from manufacturers who recycle insulation materials.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam plastic board insulation:
1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

1.8 PROJECT CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

B. Sequence Work to ensure fireproofing and firestop materials are in place before beginning Work.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS/PRODUCTS

A. Specifications are based on any of the manufacturers listed below, with their product in parenthesis for the particular insulation application. Other manufacturers not listed must have a

minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 regarding substitutions to be considered.

2.2 EXTRUDED POLYSTRENE FOAM BOARD

A. Extruded, Polystyrene Foam Board: ASTM C578, Type IV.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Dow Chemical Company (The).
      b. Owens Corning.
      c. Comparable product.

2.3 THERMAL INSULATION

A. Themal Insulation, Unfaced: ASTM C 665, Type I. with maximum flame spread and smoke developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation.
      b. Guardian Building Products, Inc.
      c. Johns Manville; a Berkshire Hathaway company.
      d. Knauf Insulation.
      e. Owens Corning.

   2. Thickness/R- Values (minimum):
      a. 3-1/2 inches/ R-11 where shown on the Drawings.
      b. 6 inches/ R-19 where shown on the Drawings.

2.4 INSULATION FASTENERS

A. Adhesively Attached, Spindle Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
   1. Plate: Perforated, galvanized carbon steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
   2. Spindle: Coppercoated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.

B. Adhesively Attached, Angle Shaped, Spindle Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
   1. Angle: Formed from 0.030 inch (0.762 mm) thick, perforated, galvanized carbon steel sheet with each leg 2 inches (50 mm) square.
   2. Spindle: Copper coated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.

C. Insulation Retaining Washers: Self-locking washers formed from 0.016 inch (0.41 mm) thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
   1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
      a. Crawl spaces.
      b. Ceiling plenums.
      c. Attic spaces.

D. Insulation Standoff: Spacer fabricated from galvanized mild steel sheet for fitting over spindle of insulation anchor to maintain air space of 2 inches (50 mm) between face of insulation and substrate to which anchor is attached.

E. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.5 ACCESSORIES

A. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

B. Asphalt Coating for Cellular Glass Block Insulation: Cutback asphalt or asphalt emulsion of type recommended by manufacturer of cellular-glass block insulation.

C. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

B. Foam in Place Insulation: Verify that substrates are clean, dry, and free of substances that are harmful to insulation.
   1. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.2 INSTALLATION

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Board Insulation: Install insulation that is undamaged, dry, and unsoiled and has not been exposed to ice, rain, or snow at any time.
   1. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
   2. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

C. Cavity Wall Insulation: Foam Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
   1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 20 00 - "Unit Masonry."
   2. Cellular Glass Board Insulation: Install with closely fitting joints using attachment method according to manufacturer's written instructions.

D. Batt Insulation (Thermal and Sound): Walls: Insulation shall be friction fit between studs and provide full coverage where indicated on Drawings. Insulation shall be tight within spaces n partitions, around cut openings, behind and around electrical and mechanical items within or behind partitions and tight to items passing through partitions. Wall areas above ceiling: At side wall insulation in ceiling cavity, install adhesive-mounted impaling devices with metal caps at 2 feet-0 inches vertically and at four (4) inches from each side of blankets horizontally. Install blankets with four (4) foot dimension running vertically on spikes, keeping blankets tight to exterior wall without crushing into each other.

E. Framed Construction: Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
   1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
   2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
   3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
   4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
   5. For metal framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

   6. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

3.3 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

SECTION 07 27 26 - FLUID APPLIED AIR BARRIER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Fluid-applied air barrier membrane in exterior wall assemblies.

B. Materials to bridge and seal the following air leakage pathways and gaps:
   1. Connections of the walls to the roof air barrier.
   2. Connections of the walls to the foundation air barrier.
   3. Seismic and expansion joints.
   4. Openings and penetrations of window frames, storefront, curtain wall and mechanical, electrical and plumbing systems.
   5. Barrier precast concrete and other envelope systems.
   6. Door frames.
   7. Piping, conduit, duct and similar penetrations.
   8. Masonry ties, screws, bolts and similar penetrations.
   9. All other air leakage pathways in the building envelope.

C. Related Work in other Sections includes but is not limited to the following:
   1. Section 01 45 00 – Quality Control
   2. Section 01 50 00 – Temporary Facilities and Controls
   3. Section 03 30 00 – Cast-In-Place Concrete
   4. Section 04 20 00 – Unit Masonry
   5. Section 07 54 23 – Fully Adhered Thermoplastic Membrane Roofing System
   6. Section 07 65 00 – Flexible Flashing
   7. Section 07 90 00 – Joint Sealants

1.3 PERFORMANCE REQUIREMENTS

A. Material Performance: Provide air barrier materials which have an air permeance not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.004 cfm / ft2 @ 1.57 psf), when tested in accordance with ASTM E2178 (unmodified).

B. Provide materials with a water vapor permeance of 10.0 US perms or greater, determined in accordance with ASTM E96 Water method (Procedure B).

C. Assembly Performance: Provide a continuous air barrier in the form of an assembly that has an air leakage not to exceed 0.04 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.04 cfm/ft2 @ 1.57 psf) when tested in accordance with ASTM E2357. The assembly shall accommodate movements of building materials by providing expansion and control joints as required. Expansion / control joints, changes in substrate and perimeter conditions shall have appropriate accessory materials at such locations.

   1. The air barrier assembly shall be capable of withstanding combined design wind, fan and stack pressures, both positive and negative on the envelope without damage or displacement, and shall transfer the load to the structure.

2. Fluid applied air barriers shall not displace adjacent materials in the air barrier assembly under full load.
3. The air barrier assembly shall be joined in an airtight and flexible manner to the air barrier materials of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations, creep, and anticipated seismic movement.

D. Connections to Adjacent Materials: Provide connections to prevent air leakage at the following locations:

1. Foundation and walls, including penetrations, ties and anchors.
2. Walls, windows, curtain walls, storefronts, louvers or doors.
3. Different wall assemblies, and fixed openings within those assemblies.
4. Wall and roof connections.
5. Floors over unconditioned space.
6. Walls, floor and roof across construction, control and expansion joints.
7. Walls, floors and roof to utility, pipe and duct penetrations.
8. Seismic and expansion joints.
9. All other potential air leakage pathways in the building envelope.

1.4 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 13 – Project Coordination

1.5 SUBMITTALS

A. Submittals: Submit in accordance with Division 1 requirements.

B. Installer Qualifications: Submit evidence of current Contractor accreditation and Installer certification under the Air Barrier Association of America's (ABAA). Submit accreditation number of the Contractor and certification number(s) of the ABAA Certified Installer(s).

C. Product Data: Submit material Manufacturer's Product Data, material Manufacturer's instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, Technical Data, and tested physical and performance properties.

1. Submit letter from primary air barrier material Manufacturer indicating approval of materials that are proposed to be used that are not currently listed in the accessories section of this specification for that Manufacturer's material.
2. Include statement from the primary air barrier material Manufacturer that the materials used in their air barrier assembly which will be used to adhere to the underlying substrate are chemically compatible to the substrate material.

D. Samples: Submit clearly labeled samples, three (3) inch by four (4) inch minimum size of each material specified.

E. Shop Drawings of Mock-Up: Submit Shop Drawings of proposed mock-ups showing plans, elevations, large-scale details, and air barrier transitions and terminations.

F. Field Test Results of Mock-Up: Submit test results of air leakage test and water leakage test of mock-up in accordance with specified standards, including retesting if initial results are not satisfactory.

G. Shop Drawings: Submit Shop Drawings showing locations and extent of air barrier assemblies and details of all typical conditions, intersections with other envelope assemblies and materials, membrane counter-flashings, and details showing how gaps in the construction will be bridged, how inside and outside corners are negotiated, how materials that cover the materials are secured

with air-tight condition maintained, and how miscellaneous penetrations such as conduits, pipes, electric boxes and similar items are sealed.

1. Include VOC content of each material, and applicable legal limit in the jurisdiction of the project.
2. Include statement that materials are compatible with adjacent materials proposed for use.
3. Include required values for field adhesion test on each substrate in accordance with ASTM D4541 (modified), using a type II pull tester.

H. Compatibility: Submit letter from primary material Manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use.

1.6 QUALITY ASSURANCE

A. Air Barrier Installer Qualifications: Air barrier Subcontractor(s) shall be accredited at the time of bidding and during the complete installation period by the Air Barrier Association of America (ABAA).

1. Fluid-applied membrane air barrier Installer(s) shall be certified in accordance with the requirements outlined by ABAA. Installers shall have their photo identification air barrier certification cards in their possession and available on the project site, for inspection upon request.

B. Manufacturer: Obtain primary ABAA Evaluated Materials from a single ABAA Evaluated Manufacturer regularly engaged in manufacturing specified fluid-applied membranes. Obtain secondary materials from a source acceptable to the primary materials Manufacturer.

C. Accredited Laboratory Testing for Materials: Laboratory accredited by International Accreditation Service Inc. (IAS), American Association for Laboratory Accreditation (A2LA), or the Standards Council of Canada (SCC).

D. VOC Regulations: Provide products which comply with applicable regulations controlling the use of volatile organic compounds.

E. Preconstruction Meeting: Convene a minimum of two weeks prior to commencing Work of this Section. Agenda shall include, at a minimum, construction of mock-up, sequence of construction, coordination with substrate preparation, air barrier materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and details of construction and chemical/fire safety plans. Attendance is required by the Fluid Applied Air Barrier System Manufacturer's field representative, representatives of related trades including covering materials, substrate materials and adjacent materials.

F. Mock-Ups: Build mock-up representative of primary air barrier assemblies and glazing assemblies including backup wall and typical penetrations as acceptable to the Architect. Mock-up shall be dimensioned no less than eight (8) feet long by eight (8) feet high and include the air barrier materials and air barrier accessories proposed for use in the exterior wall assembly. Mock-ups shall be suitable for field testing as specified in AAMA 502 and AAMA 503. Mock-ups shall be suitable for testing as specified in the following paragraph.

G. Mock-Up Tests for Air and Water Infiltration: The testing of the window and door opening(s) in the mock-up for air and water infiltration shall be in accordance with AAMA 501.2 (hand wand field testing), ASTM E1186 (air leakage location), ASTM E783 (air leakage quantification) at a pressure differential of 1.57 lb/ft² (75 Pa) and ASTM E1105 (water penetration). Use smoke tracer to locate sources of air leakage. If deficiencies are found, the air barrier Contractor shall reconstruct mock-up at their cost for retesting until satisfactory results are obtained. Deficiencies

include air leakage beyond values specified, uncontrolled water leakage, unsatisfactory workmanship.

H. Air Barrier Assembly Testing: Verify air barrier assembly testing by the material Manufacturer by visiting the ABAA website to ensure an ASTM E2357 test has been completed and to obtain results. Visit the ABAA website for the reported air barrier assembly leakage rate and illustrations or CAD details which includes the methods in which the assembly test mock-ups shall be assembled.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original packages with seals unbroken, labeled with material Manufacturer's name, product, date of manufacture, and directions for storage.

B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by material Manufacturer. Protect stored materials from direct sunlight and other sources of ultra-violet light.

C. Handle materials in accordance with Manufacturer’s recommendations.

1.8 PROJECT CONDITIONS

A. Temperature: Install fluid-applied air barrier material within range of ambient and substrate temperatures recommended by material Manufacturer. Do not apply air barrier to a damp or wet substrate.

B. Field Conditions: Do not install air barrier in snow, rain, fog, or mist. Do not install air barrier when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the Manufacturer.

C. Sequencing: Do not install air barrier material before the roof assembly has been sufficiently installed to prevent a buildup of water in the interior of the building.

D. Compatibility: Do not allow air barrier materials to come in contact with chemically incompatible materials.

E. Ultra-violet exposure: Do not expose air barrier materials to sunlight longer than as recommended by the material Manufacturer.

1.9 WARRANTY

A. Material Warranty: Provide Manufacturer’s standard product warranty, for a minimum 20 years from date of Substantial Completion.

B. Subcontractor (approved by ABAA and Manufacturer) Installation Warranty: Provide a five (5) year installation warranty from date of Substantial Completion, including all accessories and materials of the air barrier assembly, against failures including loss of air tight seal, loss of watertight seal, loss of attachment, loss of adhesion and failure to cure properly.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fluid Applied Membrane Air Barrier: Use regular, high temperature or low-temperature formulation depending on site conditions, within temperature ranges specified by Manufacturer. Subject to compliance with requirements, provide one of the following:

1. BASF Corporation: MasterSeal AWB 660, Enershield HP, Finestop RA, Senershield R, Acrostop R and Sonowall FT R. Thickness for products are as specified by Manufacturer. www.wallsystems.basf.com:

   a. AIR BARRIER MATERIAL PROPERTIES:

      1) Air permeance for this material has been tested and reported as being 0.0000 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0000 cfm/ft^2 @ 1.57 psf), at 10 mils (wet) when tested in accordance with ASTM E2178 (unmodified).
      2) Water vapor permeance for this material has been tested and reported as being 1004 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1004 ng/(Pa·s·m^2) / 17.6 US perms) at 10 mils (wet) when tested in accordance with ASTM E96 (water method – unmodified).

   b. AIR BARRIER ACCESSORY MATERIALS:

      1) Fabric Reinforcement: Sheathing fabric to be saturated with BASF Fluid-Applied Membrane for use at sheathing joints, penetrations and window rough openings.
      2) Flashing and Transition Membrane: WS Wrap polyester-faced 30-mil self-adhesive membrane or WS Membrane 20-mil self-adhesive membrane.
      3) Water-based Primer for Self-Adhesive Membranes: WS Flashing Primer.
      4) Mastics: As recommended by Manufacturer.

2. Carlisle Coatings and Waterproofing: Fire-Resist Barritech VP at 60 mils thick (wet). www.carlisle-ccw.com:

   a. AIR BARRIER MATERIAL PROPERTIES:

      1) Air permeance for this material has been tested and reported as being 0.0002 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0002 cfm/ft^2 @ 1.57 psf), at 65 mils (wet), when tested in accordance with ASTM E2178 (unmodified).
      2) Water vapor permeance for this material has been tested and reported as being 817 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (817 ng/(Pa·s·m^2) / 14.295 US perms) at 60 mils (wet) [40 mils (dry)] when tested in accordance with ASTM E96 (water method – unmodified).

   b. AIR BARRIER ACCESSORY MATERIALS:

      1) Detail Flashing: Fire-Resist 705 FR.
      2) Counter-flashing for Metal Wall Flashings: Fire-Resist 705 FR.
      3) Water-Based Primer for Detail Flashing: CCW-702 WB.
      4) Solvent-Based Primer for Detail Flashing: CCW-702 or CCW-702 LV.
      5) Solvent-Based Aerosol Primer for Detail Flashing: CAV-GRIP.
      6) Reinforcing Fabric: DCH Reinforcing Fabric.
      7) Glass Mat: LiquiFiber-W.
      8) Termination Mastic: SURE-SEAL Lap Sealant.
      9) Fill Compound: CCW-201 or CCW-703 V.

3. Dow Corning: DefendAir 200 at 15 mils thick (dry). www.buildabetterbarrier.com:

   a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.0010 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0010 cfm/ft2 @ 1.57 psf), [0.0049 liters per square meter per second under a pressure differential of 75 Pa (0.0049 L/(s·m2) @ 75 Pa)] at 15 mils (dry), when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 1387.7 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1387.7 ng/(Pa·s·m2) [24.26 US perms] at 15 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:
1) Solvent-Based Primer: Dow Corning® DefendAir Primer
2) Sealants: Dow Corning® 791 Silicone Weatherseal Sealant, Dow Corning® 756 SMS Silicone Sealant, Dow Corning® 795 Silicone Building Sealant, Dow Corning® 758 Silicone Weather Barrier Sealant
3) Transition Membrane for details and terminations: Dow Corning® 778, Dow Corning® Silicone Transition Strip
4) Flashing at Transition Membrane: Dow Corning® Silicone Transition Strip
5) Counterflashing for Masonry Through-Wall Flashings: Dow Corning® Silicone Transition Strip
6) Through-Wall Flashings or Shelf Angle Flashings: Dow Corning® 778
7) Substrate Joint Treatment: Dow Corning® 791 Silicone Weatherseal Sealant

4. Dryvit Systems, Inc: Backstop NT at 12mils thick (dry). www.dryvit.com:

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.000118 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.000118 cfm/ft2 @ 1.57 psf), [0.0006 liters per square meter per second under a pressure differential of 75 Pa (0.0006 L/(s·m2) @ 75 Pa)] at 12 mils (dry), when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 1810 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1810 ng/(Pa·s·m2) [31.65 US perms] at 20 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Transition Membrane for details and terminations: Dryvit AquaFlash and AquaFlash Mesh
2) Reinforcing / Joint Tape: Dryvit Grid Tape
3) Flashing at Transition Membrane: Dryvit AquaFlash
4) Substrate Joint Treatment: Dryvit Grid Tape with Backstop NT

5. DuPont Building Innovations: Tyvek Fluid Applied WB at 25 mils thick (wet), 25 mils thick (dry). www.Weatherization.Tyvek.com:

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.0002 cubic feet per minute per square foot under a pressure differential of 1.57 pounds

per square foot (0.0002 cfm/ft^2 @ 1.57 psf), at 25 mils (dry), when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 1384 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1384 ng/(Pa·s·m^2) / 24.23 US perms) at 25 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Solvent Based Primer for Flashing, Transition Strip and Detail Membranes: 3M High Strength 90; Denso Butyl (used with self-adhered membranes only).
2) Through-Wall Flashings or Shelf Angle Flashings: DuPont recommended through-wall flashing.
3) Sealants, Mastics, Adhesives and Tapes: DuPont Sealant for Tyvek Fluid Applied System; DuPont Tyvek Flashing and Joint Compound; fiberglass mesh tape.
4) Transition, Termination, and Detailing Membrane: DuPont StraightFlash, or DuPont Tyvek Flashing and Joint Compound (60mil).
5) Penetrations and Termination Sealant: DuPont Sealant for Tyvek Fluid Applied System.
6) Window Flashing Membrane: DuPont Tyvek Fluid Applied Flashing and Joint Compound, or DuPont Tyvek Fluid Applied Flashing – Brush Formulation, or DuPont StraightFlash with DuPont FlexWrap.
7) Joint Treatment: None (≤ 1/16” gaps); DuPont Tyvek Flashing and Joint Compound (≤ 1/4” gaps); DuPont Tyvek Flashing and Joint Compound w/ fiberglass mesh tape (≤ 1/2” gaps); DuPont StraightFlash (≤ 1” gaps).

6. Grace Construction Products: Perm-A-Barrier VP, 90 mils thick (wet), 45 mils thick (dry). www.na.graceconstruction.com:

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.0004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0004 cfm/ft^2 @ 1.57 psf), at 69 mils (wet), when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 741.6 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (741.6 ng/(Pa·s·m^2) / 12.9 US perms) at 40 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Membrane for details and Terminations: Bituthene Liquid Membrane.
2) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Perm-A-Barrier WB Primer or Perm-A-Barrier Primer Plus.
3) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: Bituthene Primer B-2 and Bituthene Primer B2 LVC or Bituthene Primer B2.
4) Through-Wall Flashings or Shelf Angle Flashings: Perm-A-Barrier Wall Flashing.
5) Sealants, Mastics, Adhesives and Tapes: As recommended by Grace Construction Products.
6) Transition Membrane: Perm-A-Barrier Detail Membrane, Perm-A-Barrier Aluminum Flashing and Perm-A-Barrier Wall Flashing.

7) Penetrations and Termination Sealant: Bituthene Liquid Membrane and as recommended by Grace Construction Products.
8) Window Flashing and Detail Membrane: Perm-A-Barrier Detail Membrane, Perm-A-Barrier Aluminum Flashing and Perm-A-Barrier Wall Flashing.
9) Joint Sealant: Refer to Technical Letter 1 for details on compatible waterproofing sealants.

7. Henry Company: Air Bloc 31 MR at 90 mils (wet). www.henry.com:

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.00024 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00024 cfm/ft^2 @ 1.57 psf), at 87 mils (wet) when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 2066 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (2066 ng/(Pa·s·m^2) / 36.12 US perms) at 44 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Transition Membrane: Blueskin SA and Blueskin SALT for low-temperature applications.
2) Water-Based Primer for Transition Membrane: Aquatec Primer.
3) Solvent-Based Primer for Transition Membrane: Blueskin Adhesive.
4) Solvent-Based Aerosol Primer for Transition Membrane: Blueskin Spray Prep.
5) Counter-flashing for Masonry Through-Wall Flashing: Blueskin TWF.
6) Sealant: HE 925 BES Sealant.
7) Reinforcing Tape: HE 183 Yellow Glass Fabric.
8) Mastics, Adhesives and Tapes: Henry 570-05 Polybitume.

8. Momentive Performance Materials, Inc.: GE Elemax 2600 at 17 mils (dry). www.ge.com/silicones:

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.0006 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0006 cfm/ft^2 @ 1.57 psf), at 17 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 581 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (581 ng/(Pa·s·m^2) / 10.16 US perms) at 17 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Solvent-Based Primer: SS80.
2) Sealants: Elemax 5000 Liquid Flashing; SilPruf SCS2000; SilPruf SCS9000; SilPruf SCS2700; SWS.
3) Transition Membrane for details and terminations: Elemax 5000 Liquid Flashing; UltraSpan UST2200; UltraSpan USM pre-formed silicone molded corners parts.

4) Substrate Joint Treatment: Elemax 5000 Liquid Flashing; SilPruf SCS2000; SilPruf SCS9000; SilPruf SCS2700; SWS.
5) Reinforcing Fabric: RF100.

9. Pecora USA: Pecora XL-Perm ULTRA VP by Pecora USA at 9 – 12 mils (dry). www.pecora.com:

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.00024 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00024 cfm/ft^2 @ 1.57 psf), 0.0012 liters per square meter per second under a pressure differential of 75 Pa (0.0012 L/(s·m^2) @ 75 Pa)] at 12 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 727.01 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (727.01 ng/(Pa·s·m2) [12.71 US perms] at 9 mils - dry when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Sealants: 890NST Silicone Sealant, AVB Silicone Sealant
2) Transition Membrane for details and terminations: XL Span
3) Flashing at Transition Membranes: XL Flash Liquid Flashing & Joint Filler
4) Counter-Flashing for Masonry Through-Wall Flashings: XL Flash Liquid Flashing & Joint Filler
5) Through-Wall Flashings or Shelf Angle Flashings: XL Flash Liquid Flashing & Joint Filler
6) Substrate Joint Treatment: XL Flash Liquid Flashing & Joint Filler, 890 NST Silicone Sealant, AC-20 Latex Sealant, AVW-920 Latex Sealant, Dynatrol I-XL-345 Tru White STPU Sealant

10. PROSOCO, Inc.: Spray Wrap MVP at 26 mils (dry). www.prosoco.com:

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.00086 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00086 cfm/ft^2 @ 1.57 psf), when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 1944 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1944 ng/(Pa·s·m^2) / 34.43 US perms) at 5 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Water-Based Primer: PROSOCO R-GUARD GypPrime for cut gyp board edged in rough openings.
2) Sealants: PROSOCO R-GUARD AirDam for interior perimeter seal in window installations.
3) Counter-flashing for Masonry Through-Wall Flashings: PROSOCO R-GUARD Joint and Seam Filler followed by PROSOCO R-GUARD FastFlash.

4) Through-Wall Flashings or Shelf Angle Flashings: PROSOCO R-GUARD Joint and Seam Filler followed by PROSOCO R-GUARD FastFlash.
5) Substrate Joint Treatment: PROSOCO R-GUARD Joint & Seam Filler for sheathing seams, PROSOCO R-GUARD Joint & Seam Filler covered by PROSOCO R-GUARD FastFlash in rough opening.

11. PROSOCO, Inc.: Cat 5 at 12 - 15 mils (wet). www.prosoco.com:

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.00018 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00018 cfm/ft^2 @ 1.57 psf), when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 1015 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1015 ng/(Pa·s·m^2) / 17.71 US perms) at 12 – 15 mils (wet) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Water-Based Primer: PROSOCO R-GUARD GypPrime for cut gyp board edged in rough openings.
2) Sealants: PROSOCO R-GUARD AirDam for interior perimeter seal in window installations.
3) Counter-flashing for Masonry Through-Wall Flashings: PROSOCO R-GUARD Joint and Seam Filler followed by PROSOCO R-GUARD FastFlash.
4) Through-Wall Flashings or Shelf Angle Flashings: PROSOCO R-GUARD Joint and Seam Filler followed by PROSOCO R-GUARD FastFlash.
5) Substrate Joint Treatment: PROSOCO R-GUARD Joint & Seam Filler for sheathing seams, PROSOCO R-GUARD Joint & Seam Filler covered by PROSOCO R-GUARD FastFlash in rough opening.

12. Protecto Wrap: Protecto Wall Liquid Air Barrier VP by at 10 mils (dry). www.protectowrap.com:

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.00086 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.000864 cfm/ft2 @ 1.57 psf), 0.0043 liters per square meter per second under a pressure differential of 75 Pa (0.0043 L/(s·m2) @ 75 Pa)] at 10 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 660.8 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (660.8 ng/(Pa·s·m^2) [11.5 US perms] at 22 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Water-Based Primer: Universal Water Based Primer.
2) Solvent-Based Primer: BT Primer.
3) Solvent-Based Aerosol Primer: Protecto-Tak Spray Adhesive.
4) Sealants: Protecto Wall Board to Baord Joint Sealant.

5) Transition Membrane for details and terminations: Protecto Wall Transition Tape.
6) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: BT Primer.
7) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Universal Water Based Primer.
8) Substrate Joint Treatment: Protecto Wall Board to Board Joint Sealant.

13. Sika Corporation: Sikagard 530 Liquid Applied Vapor Permeable Air Barrier at 30 mils (dry). www.sika.com:

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being < 0.0001 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (< 0.0001 cfm/ft^2 @ 1.57 psf), at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 661 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (661 ng/(Pa·s·m^2) / 11.5 US perms) at 22 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Water-Based Primer: Sikagard 530.
2) Solvent-Based Primer: Sikagard 510.
3) Termination Mastic: Sikaflex 11FC.
4) Sealants: Sikaflex 11FC.
5) Transition Membrane for details and terminations: SikaMultiSeal 515.
6) Reinforcing/Joint Tape: SikaMultiSeal 515.
7) Counterflashing for Masonry Through-Wall Flashings: SikaMultiSeal Plus.
8) Through-Wall Flashings or Shelf Angle Flashings: SikaMultiSeal Plus.
9) Substrate Joint Treatment: Sikaflex 11FC.

14. Soproma: Sopraseal LM 202 VP at 10 mils (wet) www.soprema.us

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.00004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00004 cfm/ft2 @ 1.57 psf), [0.0002 liters per square meter per second under a pressure differential of 75 Pa (0.0002 L/(s·m2) @ 75 Pa)] at 10 mils (wet) when tested in accordance with ASTM E 2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 1004 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1004 ng/(Pa·s·m^2) [17.6 US perms] at 10 mils (wet) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Water Based Primer: Soprema Elastocol Stick H20 Primer
2) Solvent-Based Primer: Soprema Sopraseal Stick primer
3) Sealants: Soprema Sopraseal sealant

4) Transition Membrane for details and terminations: Soprema Sopreseal Stick 1100T or Soprema Soprsolin HD
5) Substrate Joint Treatment: Soprema Sopreseal Mesh

15. Sto Corp: Emerald Coat at 20 mils (dry). www.stocorp.com:

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.000024 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00024 cfm/ft^2 @ 1.57 psf), [0.00020 liters per square meter per second under a pressure differential of 75 Pa (0.00020 L/(s·m^2) @ 75 Pa)] at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 797.94 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (797.94 ng/(Pa·s·m^2) [13.95 US perms] at 12 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Joint and Rough Opening Treatments: Sto Gold Fill with StoGuard Mesh, StoGuard Rapid Seal with StoGuard Mesh, Sto EmeraldCoat with SToGuard Fabric, StoGuard Tape
2) Joint Reinforcements: StoGuard Mesh, StoGuard Fabric, StoGuard RediCorner
3) Transition Membranes: Sto Gold Fill with StoGuard Mesh, StoGuard RapidSeal or StoGuard RapidSeal with StoGuard Mesh, Sto Emerald Cost with StoGuard Fabric, StoGuard Tape
4) Water-Based Primer for use with Flashing Transition: StoGuard

16. STS Coatings: Wall Guardian FW-100-A (Acrylic-based component) 40 mils (wet), 20 mils (dry). www.wallguardian.com:

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.0001 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0001 cfm/ft^2 @ 1.57 psf), at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 661 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (661 ng/(Pa·s·m^2) / 11.5 US perms) at 22 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: None.
2) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: BP-40 Primer for use with UT-40 Universal Tape.
3) Through-Wall Flashings or Shelf Angle Flashings: Gorilla Flash VF-1000.
4) Mastics: None.
5) Adhesives and Tapes: Universal Tape UT-40, a butyl based tape and Great Seal LT-100, a low voc elastomeric sealant for deflection joints and details.
6) Transition Strip: Universal Tape, UT-40.
7) Termination Mastic: Great Seal LT-100.

8) Window Flashing and Detail Membrane: Universal Tape UT-40.

17. TK Products: TK-AirMax 2103 at 40+ mils (wet). www.tkproducts.com:

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.00097 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00097 cfm/ft^2 @ 1.57 psf), 0.00492 liters per square meter per second under a pressure differential of 75 Pa (0.00492 L/(s·m^2) @ 75 Pa)] at 40 mils (wet) when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 857 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (857 ng/(Pa·s·m^2) [15.0 US perms] at 20 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Through-Wall Flashings or Shelf Angle Flashings: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18
2) Caulk: TK-Super Seal
3) Adhesives and Tapes: TK-AirMax 2200 All Weather Flashing (TK Products), TK Air Max 2203 Caulk, TK-AirMax 2201 Red Sheathing Facing Tape (Venture Tape, a 3M Company), 3M All-Weather Flashing Tape 8067 (3M Company), VentureStop VB 400 (Venture Tape, a 3M Company), Venture-1585 CW-2 Red Sheating Facing Tape (Venture Tape, a 3M Company)
4) Transition Membranes: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18
5) Reinforcing / Joint Tape: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18
6) Termination of Caulk: TK-AirMax Caulk 2203 (TK Products), Manus-Bond 75AM (Manus Products, Inc.)
7) Flashing (Counter) for Masonry at Through-Wall Flashings or Transition Membranes: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18

18. TK Products: TK-AirMax 2104 at 40+ mils (wet). www.tkproducts.com:

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.0008 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0008 cfm/ft^2 @ 1.57 psf), at 40+ mils (wet) when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 1007 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1007 ng/(Pa·s·m^2) / 17.6 US perms) at 14 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Through-Wall Flashings or Shelf Angle Flashings: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18.
2) Caulk: TK-Super Seal.

3) Adhesives and Tapes: TK-AirMax 2200 All Weather Flashing (TK Products), TK Air Max 2203 Caulk, TK-AirMax 2201 Red Sheathing Facing Tape (Venture Tape, a 3M Company), 3M All-Weather Flashing Tape 8067 (3M Company), VentureStop VB 400 (Venture Tape, a 3M Company), Venture-1585 CW-2 Red Sheating Facing Tape (Venture Tape, a 3M Company).
4) Transition Membranes: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18.
5) Reinforcing / Joint Tape: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18.
6) Termination of Caulk: TK-AirMax Caulk 2203 (TK Products), Manus-Bond 75AM (Manus Products, Inc.)
7) Flashing (Counter) for Masonry at Through-Wall Flashings or Transition Membranes: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18.

19. ExoAir 230, Tremco, Inc. at 40 mils (wet) www.tremcoselants.com

a. AIR BARRIER MATERIAL PROPERTIES:

i. Air permeance for this material has been tested and reported as being 0.0003 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0003 cfm/ft^2 @ 1.57 psf), [0.00011 liters per square meter per second under a pressure differential of 75 Pa (0.00011 L/(s·m^2) @ 75 Pa)] at 40 mils (wet) when tested in accordance with ASTM E2178 (unmodified).

ii. Water vapor permeance for this material has been tested and reported as being 103.72 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (103.72 ng/(Pa·s·m^2) [1.81 US perms] at 29 mils (dry) when tested in accordance with ASTM E 96 (desiccant method – unmodified).

iii. Water vapor permeance for this material has been tested and reported as being 1677 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1677 ng/(Pa·s·m^2) [29.31 US perms] at 29 mils (dry) when tested in accordance with ASTM E 96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

i. Solvent-Based Primer: ExoAir Primer
ii. Termination Mastic: ExoAir Termiantion Mastic
iii. Sealants: Tremflex 834, Dymonic 100, Spectrem 1
iv. Transition Membrane for details and terminations: ExoAir 110, ExoAir 111, ExoAir TWF, Dymonic 100
v. Reinforcing/Joint Tape: Tremco 2011 mesh
vi. Flashing at Transition Membrane: ExoAir 111, ExoAir TWF, Dymonic 100
vii. Counter-flashing for Masonry Through-Wall Flashings: ExoAir TWF
viii. Through-Wall Flashings or Shelf Angle Flashings: ExoAir TWF
ix. Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: ExoAir Primer
x. Substrate Joint Treatment: Tremflex 834, Dymonic 100 depending on substrate.

20. W.R. Meadows, Inc.: Air-Shield LMP, at 60 mils (wet), 30 mils (dry). www.wrmeadows.com:

    a. AIR BARRIER MATERIAL PROPERTIES:

        1) Air permeance for this material has been tested and reported as being 0.000096 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.000096 cfm/ft2 @ 1.57 psf), [0.00048 liters per square meter per second under a pressure differential of 75 Pa (0.00048 L/(s·m2) @ 75 Pa)] at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
        2) Water vapor permeance for this material has been tested and reported as being 598 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (598 ng/(Pa·s·m^2) [10.47 US perms] at 30 mils (dry) when tested in accordance with ASTM E 96 (water method – unmodified).

    b. AIR BARRIER ACCESSORY MATERIALS:

        1) Water-Based Primer: None required for Air Shield LMP.
        2) Solvent-Based Primer: None required for Air Shield LMP.
        3) Solvent-Based Aerosol Primer: None required for Air Shield LMP.
        4) Termination Mastic: Pointing Mastic or BEM.
        5) Transition Membrane for details and terminations: Air Shield.
        6) Reinforcing/Joint Tape: Reinforcing Fabric HCR.
        7) Flashing at Transition Membrane: Air Shield Thru-Wall Flashing.
        8) Counter-flashing for Masonry Through-Wall Flashings: Air Shield Thru-Wall Flashing.
        9) Through-Wall Flashings or Shelf Angle Flashings: Air Shield Thru-Wall Flashing.
        10) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: Mel-Prime VOC.
        11) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Mel-Prime WB.
        12) Substrate Joint Treatment: Air Shield Joint Filler.

2.2 AUXILIARY MATERIALS

A. Transition Membrane Between Air and Vapor Barrier Membrane and Roofing and Other Adjacent Materials: Comply with both air barrier Manufacturer's recommendations and roofing material Manufacturer's recommendations.

B. Provide primers, glass fabric scrim tape, mastic, and other materials not specifically described, but required for a complete and proper installation as instructed by the air barrier system Manufacturer or required to provide a continuous the air barrier assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The ABAA Certified Air Barrier Contractor shall examine substrates, areas, and conditions under which the air barrier assembly will be installed, with ABAA Certified Installer present, for compliance with requirements.

1. Confirm site access logistics and scheduling requirements, including but not limited to use of scaffolding, lifts and staging.
2. Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3. Ensure that the following conditions are met:
   a. Surfaces are sound, dry, even, and excess mortar and / or other contaminants.
   b. Inspect and confirm substrates to be smooth and without large voids or sharp protrusions. Inform General Contractor if substrates are not acceptable and need to be repaired by the substrate Subcontractor.
   c. Inspect and confirm masonry joints to be reasonably flush and completely filled, and ensure all excess mortar accumulated on masonry ties has been removed. Inform General Contractor if masonry joints are not acceptable and need to be repaired by the masonry Subcontractor.
   d. Masonry joints are flush and completely filled with mortar, and all excess mortar sitting on masonry ties has been removed.
4. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263 and take suitable measures until substrate passes moisture test.
5. Verify sealants are compatible with membrane proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.
6. Notify Architect in writing of anticipated problems using air and vapor barrier over substrate prior to proceeding.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrate according to material Manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

1. Ensure that penetrating work by other trades is in place and complete.
2. Prepare surfaces by brushing, scrubbing, scraping, grinding or compressed air to remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants which will affect adhesion of the fluid-applied membrane.
3. Wipe down metal surfaces to remove release agents or other non-compatible coatings using clean sponges or with a material chemically compatible with the primary air material.

B. Prime substrate for installation of sheet membrane transition strips as recommended by material Manufacturer and as follows:

1. Prime masonry, concrete substrates with conditioning primers.
2. Prime glass-fiber surfaced gypsum sheathing an adequate number of coats to achieve required bond, with adequate drying time between coats.
3. Prime wood, metal, and painted substrates with primer.
4. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air barrier at protrusions.

C. Prime substrate for installation of fluid-applied air barrier if recommended by material Manufacturer based on project conditions.

D. Protection from spray-applied materials as recommended by material Manufacturer and as follows:

1. Mask and cover adjacent areas to protect from over-spray.
2. Ensure any required foam stop or back up materials are in place to prevent over-spray and achieve complete seal.

3.3 INSTALLATION

A. Fluid Applied Membrane Air Barrier: Install air barrier accessories and fluid-applied membrane air barrier material to provide continuity throughout the building envelope in a shingle fashion. Install materials in accordance with material Manufacturer's instructions and the following (unless

Manufacturer recommends other procedures in writing based on project conditions or particular requirements of their recommended materials):

1. Install veneer anchors as per air barrier Manufacturer installation sequencing.
2. Apply treatment to exterior gypsum joints and screw heads as per air barrier material Manufacturer.
3. Apply primer for transition material at the rate instructed by the air barrier material Manufacturer for 1 inch beyond terminating edge of transition membrane. Allow primer to set / cure completely before transition strip application.
4. Position subsequent sheets of transition material so that membrane overlaps the membrane sheet below by a minimum of 2 inches, unless greater overlap is recommended by the material Manufacturer. Ensure transition membrane is securely sealed onto substrate with roller.
5. Overlap horizontally adjacent pieces of transition material a minimum of 2 inches, unless greater overlap is recommended by the material Manufacturer. Roll all areas of transition strip including seams with roller.
6. Seal around all penetrations with termination mastic / sealant, membrane counterflashing or other procedure in accordance with material Manufacturer's instructions, ensuring chemical compatibility amongst adjoining materials.
7. Connect air barrier in exterior wall assembly continuously to the air barrier of the roof, to concrete below-grade structures, to windows, curtain wall, storefront, louvers, exterior doors, other intersection conditions and transitions from wet cavity to dry cavity and seal penetrations using accessory materials in accordance with the material Manufacturer's instructions.
8. Provide transition material at changes in substrate plane (with bead of sealant / mastic, membrane counter-flashing or other material recommended by material Manufacturer) under membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.
9. Provide mechanically fastened non-corrosive metal sheet or other Manufacturer approved transition material to span gaps greater than 1 inch in substrate plane and to make a smooth transition from one plane to the other. Transition membrane shall be installed continuously from air barrier material onto sheet metal maintaining 2 inch overlap on both edges.
10. Lap transition material over top edge of through-wall flashing and head-flashing.
11. Provide backup for the membrane to accommodate anticipated movement or use other Manufacturer approved transition material at deflection and control joints.
12. Provide transition material to joint assemblies at expansion and seismic joints.
13. Provide backup for the fluid applied air barrier to accommodate anticipated movement at deflection and control joints as recommended by material Manufacturer.
14. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and / or as otherwise recommended by the material Manufacturer.
15. Seal top edge of the self-adhered membrane to substrate with termination mastic at end of each working day.
16. Inspect installation prior to enclosing assembly and repair punctures, damaged areas and inadequately lapped seams with a patch of membrane lapped as recommended by material Manufacturer.
17. Install primer for fluid-applied air barrier if instructed by material Manufacturer.
18. Install fluid-applied membrane using equipment and methods recommended by Manufacturer to achieve a dry film thickness as required by the material Manufacturer.
19. Do not allow materials to come in contact with chemically incompatible materials.
20. Do not expose membrane to sunlight / ultraviolet light longer than as recommended by the Manufacturer.

3.4 FIELD QUALITY CONTROL

A. Owner's Inspection and Testing: Cooperate with Owner's testing agency as applicable. Allow access to work areas and staging. Notify Owner's testing agency in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted.

B. Manufacturer's Field Representative Review: Contractor is not to commence any work other than staging until contact and meeting with the Manufacturer's Field Representative on site. The Manufacturer's Field Representative is to visit the jobsite a minimum of four (4) times to review work processes and / or work completed prior to work commencement, at 10% completion, at 50% completion and prior to the work being covered by finish materials.

3.5 PROTECTING AND CLEANING

A. Protect air barrier materials from damage during installation and the remainder of the construction period, according to material Manufacturer's written instructions.

1. Coordinate with installation of materials which cover the air barrier assemblies, to ensure exposure period does not exceed that recommended by the air barrier Manufacturer.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by Manufacturer of affected construction and acceptable to the primary material Manufacturer.

END OF SECTION 07 27 26

SECTION 07 42 16 - METAL SOFFIT PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes metal soffit panels.

1.3 DELIVERY AND STORAGE

A. All panels shall be delivered with appropriate packaging to provide protection against transportation damage. Materials damaged in shipping or storage shall not be used.

B. Store all materials and accessories above ground on well-skidded platforms. Store under waterproof covering. Provide proper ventilation to panels to prevent condensation build-up between panels.

1.3 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation when existing and forecasted weather conditions permit assembly of metal composite material panels to be performed according to manufacturers' written instructions and warranty requirements.

1.4 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including rupturing, cracking, or puncturing.
      b. Deterioration of metals and other materials beyond normal weathering.

   2. Warranty Period: Five (5) years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

   2. Finish Warranty Period: Twenty (20) years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Specifications are based on products manufactured by Petersen Aluminum Corporation (PAC-CLAD); (800) 441-8661. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with requirements of Division 1 regarding substitutions to be considered.
   1. Architectural Building Components, Inc.; (800) 423-1105.
   2. Centria, an NCI Building Systems; (800) 759-7474.
   3. MBCI; (281) 445-8555.

2.2 MATERIALS

A. Soffit Panels: Non-perforated 0.040 inch thick aluminum panels.

B. Style: One (1) inch thick Flush panel with 11 inch width

C. Finish: Factory pre-finished with an exterior surface of Kynar 500® or Hylar 5000® based coating having a resin content consisting of at least 70 percent PVDF fluoropolymer resin content, in at least 1.0 mil thickness, in color(s) selected by Architect; interior surface finish, manufacturer's standard.

D. Accessories:
   1. Concealed Fasteners: Stainless Steel screws supplied or recommended by panel manufacturer to suit application.
   2. Provide all necessary accessories, framing and support members, closures, and trim for complete installation of soffit panels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

B. Examine framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal panel manufacturer.

C. Examine sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal panel manufacturer.

D. Verify that air- or water-resistive barriers been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

E. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

G. Ensure substrates are flat, free from objectionable warp, wave and buckle and ready to receive soffit panels.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF SOFFIT PANELS

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
   1. Shim or otherwise plumb substrates receiving metal panels.
   2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
   3. Install screw fasteners in predrilled holes.
   4. Locate and space fastenings in uniform vertical and horizontal alignment.
   5. Install flashing and trim as metal panel work proceeds.
   6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
   7. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:
   1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
   2. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
   3. Copper Panels: Use copper, stainless-steel, or hardware-bronze fasteners.
   4. Stainless-Steel Panels: Use stainless-steel fasteners.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
   1. Apply panels and associated items true to line for neat and weathertight enclosure.
   2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
   3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
   4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

E. Watertight Installation:
   1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
   2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
   3. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install components required for a complete metal panel system including trim, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
   1. Install exposed flashing and trim that is without buckling, and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
   2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.4 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturers written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 16

SECTION 07 54 23 - FULLY ADHERED THERMOPLASTIC MEMBRANE ROOFING SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Providing the entire roofing assembly, including, but not limited to:
   1. Wood nailers (Refer to this Section and Section 06 10 00)
   2. Curbs (Refer to Section 07 72 00)
   3. Fully adhered thermoplastic single-ply membrane roofing
   4. Flashings, including sheet metal perimeter edge (fascia) (Refer this Section and Section 07 63 00)
   5. Walkway pads, expansion joints, and other work incidental to, the complete and proper installation of a watertight roofing system as shown on the drawings or specified herein, and in accordance with all applicable requirements of the Contract Documents.

B. It is the intent of this Section that the Work shall:
   1. Provide a watertight facility.
   2. Conform to all applicable building code requirements and of authorities having jurisdiction.
   3. Include Section 07 63 00, and Section 07 72 00, as part of the Work of this Section; and be performed by a single source contractor.
   4. Coordinate with General Contractor of temporary equipment and conduit on roof and protection of installed roof membrane.

1.2 RELATED WORK

A. All Sections of Work relating to the roofing system, including mechanical, plumbing and electrical items penetrating the roof system.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM)
   1. A 385, Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
   2. D 471, Resistance to water absorption
   3. D 751, Method of Testing Coated Fabrics
   4. D 1149 Ozone resistance
   5. D 1204 Linear Dimensional Change
   6. D 2137 Brittleness point, max,
   7. D 4637/6878(annex A1) Thickness over scrim
   8. E 96 Water vapor permeance, Perms
   9. E 903 Solar Reflectance (albedo X 100), %
   10. G 151/154 Accelerated weathering
   11. FTM 101C method 2031 Puncture resistance

B. ASCE-7 Wind uplifts requirements for geographical area.

C. Federal Specifications (FS)
   1. TT-S-00230C

D. National Roofing Contractors Association (NRCA)
   1. Roofing and Waterproofing Manual

E. Single Ply Roofing Institute (SPRI)

F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
   1. Architectural Sheet Metal Manual

G. Underwriters' Laboratories (UL)
   1. Fire Hazard Classifications

H. International Building Code

1.4 PERFORMANCE REQUIREMENTS

A. General Requirements: Provide an installed thermoplastic single ply roofing system, flashing and related work that is watertight and will not permit the passage of liquid water, able to withstand wind loads, thermally induced movement and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.

C. Roofing System Design: Comply with SPRI "Wind Design Guide for Fully Adhered Roofing Systems" for the following ground roughness exposure and system design:
   1. Check for geographical exposure (i.e. Exposure B: City, suburban areas, towns and wooded terrain.)
   2. Fully Adhered single-ply membrane roofing.

D. Underwriter's Laboratories Inc. (UL)
   1. UL RMSD – Current Roofing Materials and Systems Directory
   2. UL Fire Resistance of Roofing Coverings Materials
   3. Exterior Fire Exposure Classification: Class A, ASTM E 108, for application and slopes shown.

E. ASCE-7 Wind uplifts requirements for geographical area.

F. American National Standards Institute (ANSI)

G. American Architectural Manufacturer's Association (AAMA)

H. Occupational Safety and Health Administration (OSHA)

I. International Building Code (IBC)

1.5 SUBMITTALS

A. Product Data: Manufacturer's printed instructions, schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, adhesive, and accessories to be used in the Work.

B. Certifications:
   1. Manufacturer's written certification that installer is approved and licensed to install specified roofing system. (Submit a copy with Proposal Form)
   2. Manufacturer's affidavits that materials used in Project contain no asbestos.
   3. Installer shall submit resume and project experience list for proposed system for Project Manager and job site superintendent.
   4. Installer shall submit written certification that there are no undocumented workers being employed by them or any subcontractor on this project and that covers all workers on this project by workmen's compensation.

5. Installer shall submit list of all subcontractors with evidence of subcontractor's insurance coverage in compliance with contract requirements.
6. Manufacturer's written certification of approval / acceptance of these specifications and details.

C. Referenced Standards: Two (2) copies of each referenced standard and retain approved copies at site.

D. Shop Drawings: Furnish from copies of the Manufacturer's literature or from copies of NRCA "Roofing and Waterproofing Manual", fourth edition.
1. Furnish for approval any proposed details, which differ from those, included with this proposal package. All proposed details shall first be approved in writing by roofing manufacturers prior to submitting to Architect for approval.
2. Furnish detail project sequencing, staging, material loading, manpower plans, and project construction schedule for approval.

E. Samples:
1. Furnish copy of sample warranty that is to be issued upon project completion.
2. Furnish samples of roof membrane.
3. Furnish sample of metal edge to be installed.

F. Upon Substantial Completion of Work, submit the following to Architect for his submission to Owner:
1. Manufacturer's Warranty: Manufacturer's written warranty as specified.
2. Contractor's Warranty: Contractor's written warranty as specified.
3. Maintenance Procedures: Three (3) copies of Manufacturer's printed instructions for Owner's use regarding care and maintenance of roof.
4. Affidavits of non-asbestos for material.
5. Affidavits from material manufacturers, suppliers and sub-contractors for release of liens.
6. Refer to section 01 78 39 for additional requirements of close-out documents.

1.6 INSPECTIONS / TESTS

A. The Architect's and Manufacturer's representative shall at all times have access to the job site and work areas. The contractor will provide proper and safe facilities for such access and inspection.
1 Architect Inspections: The Architect will be providing periodic inspections throughout the duration of the project. Architect's Representative shall be required to inspect after completion of each major phase of construction for approval.
2 Manufacturer Inspections:
a. An inspection shall be made by a representative of the material manufacturer a minimum three (3) times monthly during performance of Work to ensure that said project is installed in accordance with the Manufacturer's specifications and illustrated details. Written reports by the manufacturer shall be turned over to the Architect, on each Monday following the prior week.
b. The authorized material Manufacturer's field representative shall be responsible for:
1) Keeping the Architect's representative informed after periodic inspections as to the progress and quality of the work observed.
2) Calling to the attention of the contractor those matters observed which are considered to be in violation of the contract requirements.
3) Reporting to the Architect's representative, in writing, any failure or refusal of the contractor to correct unacceptable practices called to his attention.

4) Confirming, after completion of the work and based on his observation and test, that he has observed no application procedures in conflict with these specifications.

B. Any failure by the Architect's or Manufacturer's Representative to detect, pinpoint, or object to any defect or noncompliance of these specifications of work in progress or completed work shall not relieve the contractor, or reduce, or in any way limit, his responsibility of full performance of work required of him under these specifications.

C. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM standard procedures.
1. Owner will select testing laboratory and will pay for Work required by testing laboratory.
2. Re-tests for work which fail initial tests or inspections shall be paid by contractor.
3. **Non compliance with contractor requirements will result in the Architect / Owner to assign full time quality control and will be subject to reimbursement by the construction manager/contractor**.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Classification by Underwriters' Laboratories, Inc. as a Class A roof covering.
2. Roofing system shall be installed in accordance with ASCE-7 wind uplift requirements for geographical location and a 150 MPH 3-second gust wind speed zone with an importance factor of 1.15 based on IBC requirements. Wind-resistance loads listed below have a safety factor of 2.0 incorporated into the calculation.
    a. Zone 1 Field -58.8 or as otherwise referenced in Structural Documents
    b. Zone 2 Perimeter -98.6 or as otherwise referenced in Structural Documents
    c. Zone 3 Corner -148.4 or as otherwise referenced in Structural Documents
3. Follow local, state, and federal regulations of safety standards and codes. Refer to applicable building code or International Building Code for roofing system installation requirements and limitations.

B. Installer shall be an experienced single firm specializing in the type of roofing and sheet metal work required, employing only experienced workers for the class of work in which they are employed, having at least ten (10) years successful experience on projects similar in size and scope and acceptable and licensed as applicators by the material manufacturer.

C. No subcontracting of sheet metal fabrication or installation will be accepted. Contractor must have a sheet metal shop on the company premises.

D. Contractor: The contractor is responsible for the management and control of the work. He shall give his personal superintendence of the work or have a competent resident manager or superintendent satisfactory to the Architect on the job site at all times while work is in progress, with full authority to act for the contractor as his agent.

E. Work and materials hereinafter specified shall be best of kind described and, unless specified otherwise, shall be new and of best quality. All roofing materials utilized in performance of each type of work shall be the products of one manufacturer or supplier. Unless otherwise indicated, the materials to be used in this specification are those specified and denote the type, quality, performance, etc. required. All proposals shall be based upon the use of the specified material.

F. Materials will be securely fastened in place in a watertight, neat and workmanlike manner. Contractor shall plan and conduct the operations of the work so that each section started on one day is complete, details installed and thoroughly protected before the close of work for that day.

G. Application of materials shall be in accordance with the Manufacturer's recommendations. In the instance of a conflict between these specifications and those of the manufacturer, the most stringent shall take precedence.

H. Contractor shall take all necessary precautions to protect the new roof mat and deck from damage. The contractor shall be responsible for repairing all new areas of damage caused by the negligence of the contractor, at the contractor's expense. The Architect's on-site representative shall determine damage caused by contractor negligence.

I. Contractor shall keep the job clean and free from all loose materials and foreign matter. Contractor shall take necessary precautions to keep outside walls clean and shall allow no roofing materials to remain on the outside walls.

1.8 INSTALLATION CONFERENCE

A. Refer to Section 01 31 13 – Project Coordination.

1.9 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials in Manufacturer's original unopened packaging with all tags and labels intact and legible. Carton and can labels, shall indicate appropriate warnings, storage conditions, lot numbers, and usage instructions. Handle and store materials and equipment in such a manner as to avoid damage. The proper storage of materials is the sole responsibility of the contractor. Materials damaged in shipping or storage shall not be used. Wet or damaged roofing materials shall be discarded, removed from job site, and replaced with new materials prior to application.

B. Manufacturer's packaging and / or roll plastic is not acceptable for exterior storage. Tarpaulin with grommets shall be accepted minimum for exterior coverings. All materials stored, as above shall be minimum of four (4) inches off the substrate, and the tarpaulin tied off with rope.

C. Products liable to degrade as a result of being frozen shall be maintained above 40□ F in heated storage.

D. Moisture sensitive products shall be maintained in dry storage areas or properly covered. Roofing insulation and felts must always be covered or stored in a dry area when not being used.

E. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

1.10 WARRANTY

A. Roofing Manufacturer: Warrant the roofing and associated Work for 20 years from date of Substantial Completion as follows:
   1. The warranty shall be a NDL "No Dollar Limit" / no penal sum type, with total replacement cost.

2. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation, with NO exclusion for ponding water.
3. The roof system including roofing insulation, flashing, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.
4. Any and all applicable reflectivity warranty or puncture resistance warranty that are applicable to the material or system that applies, will be included in the manufactures warranty.

B. Roofing Contractor: Jointly with any subcontractors employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the building will be and remain waterproof for a five (5) year warranty period, after the Architect accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the Contractor, and subcontractors, to make good the requirements of the warranty. The warranty will be held jointly with the Bonding Company for the first two (2) years and the manufacturer for the remaining three (3) years.

C. Make arrangements with the materials manufacturer to provide the required warranty. Final warranty shall be submitted to Owner at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

A. The components of the roof system are intended to be products of a single manufacturer as required providing the specified system warranty. Products not manufactured by the membrane manufacture, but are required in the roofing assembly, will be recognized by the roofing manufacture and covered under the manufactures warranty.

B. Install all materials in accordance with Manufacturer's current written specifications and details. Deviations shall not be made without prior written approval from the manufacturer and the Owner's Representative. Should any specifications or details conflict with the Contract Documents, submit to Owner the recommended alternative that provides the best long term moisture protection and complies with Manufacturer's warranty requirements for approval.

2.2 APPROVED MANUFACTURERS

A. Specifications are based on "G410 EnergySmart Feltback Decor" Sarnafil's, fully adhered PVC single-ply roofing system with simulated standing seams manufactured by Sika Sarnafil. Manufacturers whose products meet or exceed the specifications, who have manufactured and installed roof materials and systems of the type specified for a minimum of ten (10) years and who maintains a single source responsibility for the total roofing system, as described herein, may apply for approval as a substitution in accordance with Division 1 requirements regarding substitutions.
1. Carlisle, Inc.
2. Seaman Corporation
3. Johns Manville
4. GAF Everguard

B. All materials shall be manufactured, specified, or accepted in writing by membrane manufacturer issuing the warranty. Proposed materials shall ensure full system warranty from said manufacturer. Installer shall be an applicator licensed by the manufacturer.

C. Samples of all materials used on the project, which are not supplied by the membrane manufacturer, shall be submitted to the membrane manufacturer for written approval prior to starting work.

D. All materials used on the project shall be asbestos free.

2.3 ROOF MEMBRANE ASSEMBLY

A. Thermoplastic Sheet: Uniform, flexible sheet formed from polyvinyl chloride, complying with ASTM D 4434, of the following type, thickness, and exposed face color:
   1. Classification Type III, polyester-reinforced Thermoplastic.
   2. Thermoplastic Polymer Thickness:
      a. Base Proposal: 60 mils
   3. FM Approved
   4. UL Class A.
   5. Exposed Face Color: White
   6. Initial SRI, 104. 3-Year SRI, 85.

B. Physical Properties:

Property	Value	Test Method
Overall Thickness, mil	0.060	ASTM D 638
Thickness Over Scrim, mil	27	
Felt Weight, oz. per sq. yd.	9	
Breaking Strength, lbf	80	ASTM D 751
Elongation at Break, %, Machine Direction	250	ASTM D 751
Elongation at Break, %, Cross Machine Direction	220	ASTM D 751
Seam Strength, % of Original	Pass	ASTM D 751
Retention of Properties After Heat Aging		ASTM D 3045
Tensile Strength, % of Original	Pass	ASTM D 751
Elongation, % of Original	Pass	ASTM D 751
Tearing Resistance, lbf	17.5	ASTM D 1004
Low Temperature Bend at -40° F	Pass	ASTM D 2136
Accelerated Weathering Test		ASTM G 154
(Fluorescent) - 10, 000 hours	Pass	
Cracking (7x magnification)	None	
Discoloration (by observation)	Negligible	
Crazing (7x magnification)	None	
Linear Dimensional Change, %	0.02	ASTM D 1204
Weight Change after Immersion in Water, %	1.9	ASTM D 570
Static Puncture Resistance, lbf	Pass	ASTM D 5602
Dynamic Puncture Resistance, ft-lbf	Pass	ASTM D 5635

2.4 ROOF INSULATION

A. All insulation shall be approved in writing by the membrane manufacturer as to thickness, type, and manufacturer. All insulation must be approved for the specific application, with UL and FM approval.

B. Recover Board: Glass-Faced Gypsum Roof Board equal to UL rated Type X “Dens Deck Prime” as produced by Georgia-Pacific. Board sizes shall be 48" x 96" x 1/2" or as indicated on drawings for roof assembly. Provide as required by manufacture recommendation primer for Roof System. Approved substitute, SECUROCK by USG.

C. Substrate Board: 5/8 inch thick Gypsum Board, tapered-edged, conforming to ASTM C36, Type X. Sizes shall be 4 feet-0 inches wide by longest practical length to minimize joints.

D. Polyisocyanurate Roof Insulation: (As Needed) Shall comply with ASTM C1289 and Federal Specification (FS) HH-I-1972/Gen and HH-I-1972/2, with a 20 psi minimum compressive strength. Insulation shall be surfaced on both sides with a non-asphaltic fiberglass facer. Thickness shall be a minimum total of 4.50" (or size specified on drawings) and installed in two layers. Approved product shall be E'NRGY 3 as manufactured by Johns Manville or pre-approved substitute.

E. Tapered Insulation: Factory cut 48 inches x 48 inches polyisocyanurate board; slope and thickness to vary as required to achieve a minimum 1/4 inch per foot finished slope unless noted otherwise on the Drawings; ASTM C1289, UL Class A, Factory Mutual Class 1. Approved product shall be Tapered ENRGY 3 manufactured by Johns Manville or pre-approved substitute. Provide 1/2 inch recovery board similar to that specified above over tapered polyisocyanurate board insulation.

F. Tapered Edge Strip: 1-1/2 inches to 0 inches (or as required, field verify), 18 inches x 48 inches, install at all expansion joints, curbs, projections, crickets, saddles and base flashings. Approved material shall be as manufactured by Johns Manville or pre-approved substitute.

2.5 ACCESSORIES

A. General: Furnish auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing materials.
1. Furnish liquid-type auxiliary materials that meet VOC limits of authorities having jurisdictions.

B. Flashing and Flashing Accessories: As recommended by the Thermoplastic sheet Manufacturer's printed instructions for reinforced sheet flashing of same material, type, thickness, and color as sheet membrane.

C. Fasteners: FM Approved corrosion resistant steel screws of the appropriate size for fasteners for roof membrane and insulation attachment and for sheet metal flashing. Fasteners for the membrane shall be supplied by the thermoplastic manufacturer and are to be installed as recommended by Thermoplastic sheet Manufacturer's printed instructions.
1 Shall be Factory Mutual approved and supplied by the manufacturer for the specific application.
2 Fastener for Brick: Shall be 1/4 inch x 2 inches, stainless steel nail, one piece unit, flat head, as manufactured by Rawl Zamac Nailin, or approved equal.
3 Fastener for Wood and Metal Deck: Shall be a #14 Factory Mutual approved fastener, fluorocarbon coated, with CR-10 coating. A minimum 0.200 inch diameter shank and 0.250 inch diameter thread. To be used with Factory Mutual approved, round pressure plates or bar, and having a fluorocarbon CR-10 coating, when subjected to 30 Kesternich cycles (DIN 50018) shows less than ten percent (10%) red rust which surpasses Factory Mutual Approval Standard 4470 as manufactured by Olympic Manufacturing Group, Inc., or pre-approved equal.
4 Nails: G-90 galvanized or non-ferrous type, size as required to suite application, minimum 11 gauge with 3/8 inch diameter head.
5 Iron-Lok Toggle: Shall be a toggle bolt with minimum 0.215 inch diameter shank and minimum 20 threads per inch, with a 2-1/2 inch wing span, with wing activated adhesive and pressure plate, as manufactured by Olympic Manufacturing Group, Inc.

D. Bonding Adhesive: As recommended by thermoplastic sheet Manufacturer's printed instructions to develop a bond between the membrane and the substrate to which the membrane is to be attached. Sure-Weld Bonding Adhesive or approved substitute.

E. Decorative Standing Seam: Manufacturer's standard PVC extrusion used to emulate the appearance of a standing seam metal rib roof system. Each rib is 1" high with a base width of 1-3/8" and a profile width of ½". Ribs are 10'-0" long.

F. Metal Termination Bars: Manufacturer's standard aluminum bars, approximately 1-inch (25-mm) wide, roll formed and pre-punched.

G. Metal Battens: Manufacturer's standard aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, pre-punched.

H. Metal Flashings, Copings, Edge Trim and Accessories: Provide all roofing Manufacturer's metal required for a complete roofing system covered under the Manufacturer's warranty.

I. Sealants: Membrane Manufacturer's approved sealant shall be used to seal penetrations through the membrane system and at miscellaneous sealant applications that come in contact with roof systems components.

J. Air Seal Membrane: If required by manufacturer to meet wind design requirements. Air seal membrane shall be a minimum 4 mil. Polyethylene sheeting or as required by roof system manufacturer.

K. Sealing Tape Strip: Compressible foam with pressure-sensitive tape on one side. Sealing tape strip is to be used with metal flashing as a preventive measure against air and wind blown moisture entry.

L. Walkpads / Protection Pads: Provide a polyester reinforced, weldable membrane with embossment similar to a chevron pattern.
   1. Provide walk pads shall be installed at point of roof access, at service points of all roof mounted equipment requiring periodic maintenance.
   2. Protection pads shall have rounded corners and extend minimum four (4) inches beyond edge of overlying element.
   3. Provide new protection pads under all pipe supports, at HVAC and mechanical access points, in front of all roof top doors and openings.

M. Miscellaneous Accessories: Provide pourable sealants, performed cone and vent sheet flashings, pre-formed inside and outside corner sheet flashings, T-joint covers, termination reglets, and other accessories as recommended by roofing system manufacturer for intended use.

N. Other miscellaneous materials shall be of the best grade available and approved in writing by roof system manufacturer, prior to use, for the specific application.

PART 3 - EXECUTION

3.1 PROJECT CONDITIONS

A. Existing Conditions: Examine existing building and new construction to determine existing physical conditions that affect installation of new roofing.

B. Weather Limitations: Proceed with roofing work only when existing and forecasted weather conditions permit roofing to be installed according to Manufacturer's written instructions and warranty requirements.

C. Environmental Requirements:
   1. Apply roofing in dry weather.
   2. Do not expose roof components and flashing in inclement weather or when it is predicted 30% or more possibility for inclement weather.
   3. When ambient temperature is below 40 degrees Fahrenheit, expose only enough sensitive cements, sealants, and adhesives as required for use within a four-hour period.
   4. Do not expose membrane and accessories to a constant temperature of 180 degrees Fahrenheit.

D. Protection:
   1. Provide special protection and avoid traffic on completed areas of membrane installation.
   2. Restore to original condition or replace work or materials damaged during handling of roof materials.
   3. Take precautions as required to protect adjacent work and structures.

E. Emergency Equipment: Maintain on site equipment necessary to apply emergency temporary edge seal in event of sudden storms or inclement weather.

F. Restrictions:
   1. Comply with General Requirements on use of site.
   2. Smoking is prohibited on all roof areas or in existing buildings.
   3. Maintain facility and all utility services in a functional condition.
   4. Provide sanitary facilities for employees.

3.2 EXAMINATION

A. Examine and verify that receiving substrate surfaces of the structure have no defects or errors, which would result in poor or potentially defective application or cause latent defects in workmanship.
   1. Examine substrate to which roofing material is to be applied to ensure that its condition is satisfactory for roofing application. Do not permit voids greater than 1/4 inch wide in the substrate. Substrates for roofing materials shall be dry and free of oil, dirt, grease, sharp edges, and debris. Inspect substrates, and correct defects before application of thermoplastic sheets.

B. Verify that roofing openings and penetrations are in place and set and braced and that roof drains are properly clamped into position.

C. Do not proceed with installation until unsatisfactory conditions have been corrected. Starting installation shall imply acceptance of surfaces and conditions.

3.3 NAILERS

A. Wooden nailers shall be installed at perimeter edges or drip edges on outside perimeter of building.

B. All Construction: Nailers shall be the same height as the new insulation being installed or to existing raised roof edge whichever is applicable. Nailers shall be anchored to resist a pullout force of 300 pounds per linear foot per Factory Mutual Data Sheet 1-49. Fasteners shall be no less than two (2) per nailer, and be spaced at three (3) feet on center maximum. Provide nailers at all penetrations. Raise all curbs, flashing, etc, a minimum of eight (8) inches above the deck.

3.4 SUBSTRATE PREPARATION

A. Substrate Surface: Prepare substrate surfaces to insure proper and adequate installation, in strict accordance with the Contract Documents and approved Shop Drawings, or Manufacturer's requirements.

B. Fill all gaps and voids between substrate components that are wider than 1/4 inch. Fill all gaps with same materials as the substrate.

C. The membrane manufacturer shall specify types of substrates that are suitable for use with the bonding adhesive.

D. Protection of Adjacent Areas or Surfaces: Protect adjacent areas or surfaces from damage as a result of the Work of this section. Remove sharp projections.

E. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

F. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of the roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.5 APPLICATION OF INSULATION

A. General: (As required per roof area)
1. Manufacturer's Instructions: In regard to attachment, the Manufacturer's instructions or specifications shall determine the suitability for an application.
2. Fastener pull out test will be required for verification of condition of the metal decking and suitability of Manufacturer's metal fasteners
3. Precautions: The surface of the insulation must not be ruptured due to overdriving of fasteners. The surface of the insulation or substrate shall be inspected prior to installation of the Thermoplastic roof membrane. The substrate shall be clean, dry and smooth with no excessive surface roughness, contaminated surfaces or unsound surfaces such as broken, delaminated, or damaged insulation boards. Any wet, broken, delaminated, or damaged insulation shall be replaced with new insulation.
4. Thermal insulation boards shall be laid on the substrate in parallel rows with end joints staggered and butted as close as possible. All joints shall be tight and at the roof perimeter and roof penetrations, insulation shall be cut neatly and fitted to reduce openings to a minimum. All openings 1/4 inch or larger shall be filled with insulation.
5. No more insulation shall be installed than can be covered by the completed roof system by the end of the day or the onset of inclement weather.
6. Tapered insulation and crickets, when specified, shall be placed in accordance with the drawings and / or as required NRCA standards.

B. Specified ISO insulation shall be mechanically attached to metal deck meeting Factory Mutual recommendations for I-90 wind uplift as dictated by wind zone applicable to location of project. Subsequent layer of recovery board shall be full adhered to underlying ISO insulation in low rise foam meeting Factory Mutual recommendations for I-90 wind uplift as dictated by wind zone applicable to location of project. Adhesive and thickness shall be determined by building height, location and geographical area of the United States. It is the contractor's responsibility to consult current publications, literature, and bulletins of Factory Mutual and the manufacturer that are in effect at the time of this project.

C. Insulation shall be laid bearing on deck surface / flats. The long dimension of base insulation layer must be fully supported by the top flange of the metal deck. The edges of insulation boards must not cantilever over the flutes of the metal deck.

3.6 INSTALLATION OF PVC MEMBRANE

A. General: Install in strict accordance with Manufacturer's latest published requirements, instructions, specifications, and details and approved shop drawings.

B. Over the properly installed and prepared substrate, manufactures adhesive (Sure-Weld Adhesives or approved substitute) shall be poured out of the pail and spread using notched ¼" X ¼" X ¼" rubber squeegees. The adhesive shall be applied at a rate according to manufacture requirements. No adhesive is applied to the back of the membrane. ***Do not allow adhesive to skin over or surface-dry prior to installation of membrane.***

C. The roof membrane is unrolled immediately into the wet adhesive. Adjacent rolls overlap previous rolls by 3 inches. This process is repeated throughout the roof area. Immediately after application into the adhesive, each roll shall be firmly pressed into place with water filled, foam covered lawn roller by frequent rolling in two directions. ***Do not allow adhesive to skin over or surface dry prior to installation of membrane.***

D. Weld cover strips at all seams that do not have a factory selvage edge.

3.7 SEAM INSTALLATION

A. Clean seam areas, overlap sheets, and weld side and end laps of sheets and flashings according to Manufacturer's written instructions to ensure a watertight seam installation. Weld seam as follows:
   1. Weld Method: Hot Air

B. Test lap edges with probe to verify seam weld continuity on a daily basis. Perform pull-tests of welded lap seam samples daily and install T-joint patches at all t-joint intersections of membrane and flashing seams.

C. Repair tears, voids, and lapped seams in roofing that does not meet requirements.

3.8 FLASHING INSTALLATION

A. Install sheet flashings and performed flashing accessories and adhere to substrate according to roofing system Manufacturer's written instructions.

B. ¾" plywood is to be used at all parapets that receive wall flashings.

C. Apply bonding adhesive to substrate and underside of flashing sheet at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.

D. Flash penetrations and field-formed inside and outside corners with sheet flashing as recommended by manufacturer.

E. Clean seam areas, overlap seams, and firmly roll flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.

F. Test lap edges with probe to verify seam weld continuity. Apply lap sealant, if required by roofing manufacturer, and seal exposed edges of sheet flashing terminations per Manufacturer's requirements.

G. Terminate and seal top sheet flashings and mechanically anchor to substrate through termination bars.

3.9 METAL FLASHINGS, COPINGS, EDGE TRIM AND ACCESSORIES INSTALLATION

A. General: Secure metal flashings accessories at roof edges according to FM Loss Prevention Data Sheet 1-49 for specified wind zone.

3.10 SIMULATED STANDING SEAM INSTALLATION

A. Note: Work pertaining to the installation of Décor shall only be done by Applicator personnel that have completed a mandatory one day Décor installation and welding training course. Proper installation is critical to achieve the desired appearance.

B. Simulated standing seams shall be installed parallel with roof slope where possible. Top surface of roof system membrane must be clean to obtain a proper weld for standing seam to roof system membrane and to enable positive traction for welding equipment.

C. Unless noted otherwise on the drawing, the simulated standing seam spacing is to be 16" on center and evenly spaced so that each end is not less than ½ of the spacing.

D. Preassemble simulated standing seams on the roof to the required length. Join individual lengths using connector and push together. Simulated standing seams should generally be lined up with the edge of the membrane overlap. Do not cover overlap.

E. Check all deck membrane seams with rounded screwdriver and re-weld any inconsistencies before simulated standing seam installation.

F. Position automatic welding machine to start the weld. Regularly check the simulated standing seam guide. **Installation of standing seams in a serpentine pattern or anything other than straight / true lines is unacceptable and will be reinstalled.** Extra attention is required during welding of standing seams to ensure that the automatic welding machine is traveling in a straight line.

G. Heat weld a piece of colored roofing membrane over the exposed end of the simulated standing seam. Trim as required.

3.11 QUALITY CONTROL

H. Roofing Applicator: On-site evaluation welded seams shall be made by the contractor to locations as directed by the owner's representative or PVC Manufacturer's technical representative. Two-inch wide cross-section samples shall be taken three times a day minimum through completed seams. Correct welds shall display failure from shearing of the membrane prior to separation of weld. The contractor at no extra charge to the owner shall patch each test cut. Test seam samples shall be label with location of seam cut, date of seam cut, and retain for owner's representative or PVC Manufacturer's technical representative for test cut inspection.

I. Manufacturer's Quality Control Inspection: The Manufacturer's Technical Representative shall review the on-going work on a minimum of one time every 10 working days. All defects noted non-compliance with the specifications or the recommendations of the thermoplastic manufacturer should be itemized in a punch list. These items must be corrected immediately by the contractor to the satisfaction of the owner's representative and the thermoplastic manufacturer.

3.12 PROTECTING AND CLEANING

A. Protect sheet membrane roofing from damage and wear during remainder of construction period.

B. Immediately remove all spots, smears, stains, residues, adhesives, etc., from the Work of this Section and / or upon adjacent areas or surfaces, which result from the Work of this Section.

C. Upon completion of the Work of this Section, dispose of, away from the Site, all debris, trash, containers, residue, roofing remnants and scraps which results from the Work of this Section.

D. Correct deficiencies in or remove roofing that does not comply with requirements, repair substrates, reinstall roofing, and repair sheet flashings to a condition free of damage and deterioration at the time of Substantial Completion and according to warranty requirements.

3.13 ACCEPTANCE

A. Prior to demobilization from the site, the Owner / Project Manager, Architect and Installer shall review the work. All defects noted noncompliance with the specifications or the recommendations of the PVC Manufacturer should be itemized in a punch list. These items must be corrected immediately by the contractor prior to demobilization to the satisfaction of the Owner / Project Manager, and the PVC Manufacturer.

B. Notify Architect and Owner 48 hours in advance of the date and time of inspection.

C. All warranties as required for the project of this specification shall be submitted for approval prior to final payment.

END OF SECTION 07 54 23

SECTION 07 62 00 - ROOF RELATED SHEET METAL

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable to this Section.

PART I - GENERAL

1.1 SECTION INCLUDES

A. It is the intent of this Section that the Work shall:
   1. conform to all applicable building code requirements and of authorities having jurisdiction;
   2. include all shop and field formed sheet metal work shown on drawings, specified or required, including, but not limited to:
      a. Roof penetration sleeves and hood and umbrella counterflashing
      b. Metal counterflashing
      c. Expansion joint
      d. Roof drains
      e. Scuppers
      f. Metal perimeter edge
      g. Gutters, Downspouts, Splash Blocks and Splash Pans
      h. One-way roof moisture relief vents
      i. Metal gravity vents
      j. Metal heat exhaust vents
      k. Sanitary vent pipes
      l. Pipe box
      m. Copings, trim and miscellaneous sheet metal accessories.
   3. be part of the Work of the Roofing System; and
   4. be performed by a single source contractor.

1.2 RELATED WORK

A. Section 07 54 23 – Fully Adhered Thermoplastic Membrane Roofing System

B. Section 07 72 00 – Roof Accessories

C. All Sections of Work relating to or affecting the roofing system, including mechanical, plumbing and electrical items.

1.3 REFERENCES

A. ASTM International (ASTM)
   1. A525, Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
   2. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
   3. B32, Standard Specification for Solder Metal
   4. C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

B. ASCE 7

C. Federal Specifications (FS)
   1. QQ-L-201 for lead

D. National Association of Architectural Metal Manufacturers (NAAMM)

E. National Roofing Contractors Association (NRCA)
   1. Roofing and Waterproofing Manual

F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
   1. Architectural Sheet Metal Manual

G. ANSI / SPRI ES-1

1.4 SUBMITTALS

A. Product Data:
   1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
   2. Manufacturer's installation instructions.

B. Shop Drawings: Indicating sizes, configurations, details of attachment to related and adjacent work, materials, and finishes.

C. Samples:
   1) Full range of finish colors for Architect's selection.
   2) 12 inch long sample of each specified item with approved finish.
   3) Provide full size mockup of all shop built assemblies.
   4) Documentation of Wind uplift requirements for Roof Edge for specific project location
      a. Wind Calculator available online

1.5 QUALITY ASSURANCE

A. Single Source Responsibility: Fabricator and installer of roof-related flashing, installer of prefabricated edge metal and accessories shall be the same as the membrane roof installer.

B. Comply with governing codes and regulations of authorities having jurisdiction.

C. ANSI / SPRI ES-1: Install sheet metal edge flashings and copings to comply with requirements of ANSI / SPRI ES-1 / FM 1-49 for minimum of up to 160 MPH wind speed zone and wind resistance loads.

1.6 INSTALLATION CONFERENCE

A. Refer to Section 01 31 13, Project Coordination.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, handle and store materials in accordance with manufacturer's instructions.

B. Handle and store materials and equipment in such a manner as to avoid damage.

C. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

1.8 WARRANTIES

A. Manufacturer's Product Warranty:
   1) Manufacturer's standard 30 year Kynar 500 or Hylar 5000 Finish warranty signed by the manufacturer, with guarantee covering any failure of the fluoropolymer finish during the warranty period.
   2) Failure is defined to include, but not be limited to:
      a. Deterioration of finish, such as fading, discoloring, peeling, cracking, corroding, etc.
   3) Wind Warranty
      a. Non Coastal: up to 160 MPH Blow Off Resistance, 20 Year
      b. Coastal: 215 MPH, Lifetime of Roof installed on
   4) Correction may include repair or replacement of failed product as outlined in Warranty Documents
   5) Finish warranty and wind warranty shall be delivered by Roofing Contractor to Owner at the conclusion of project as part of project closeout documents.

B. Roofing Contractor's Warranty:
   1. Contractor shall warrant the installation and related work to be free from defects in workmanship and materials, and that the metal flashings will be and remain watertight and secure, for a period of five (5) years from date of Substantial Completion.
   2. Defects shall include, but not be limited to:
      a. Leaking water on the exterior of the building, causing staining or discoloration of wall/exterior surface.
      b. Leaking water or bitumen within building or construction.
      c. Becoming loose from substrate/blocking.
      d. Loose or missing parts.
      e. Finish failure as defined above.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Metal Era, Inc., which is located at: 1600 Airport Rd.; Waukesha, WI 53188; Toll Free Tel: 800-558-2162; Tel: 262-549-6900; Fax: 800-373-9156; Email: request info (info@metalera.com); Web:www.metalera.com

B. Requests for substitutions will be considered in accordance with provisions of Section 012513.

C. Manufacturers named within specification are approved for use on the Project providing:
   1. their products meet or exceed the specifications;
   2. company has a minimum of five (5) years' experience manufacturing products of the type specified;
   3. products have been tested in conjunction with roofing membrane system as an assembly and as such has obtained the same approval and rating as the roofing membrane system; and
   4. products are approved for use by the roofing membrane manufacturer.

2.2 SHEET METAL MATERIALS

A. General Requirements: Roofing sheet metal system shall have been tested in conjunction with roofing membrane system as an assembly and have the same approval and rating as the roofing membrane system.

B. Prefinished Galvanized Sheet Steel:
   1. Commercial quality ASTM A527 G-90 hot-dip galvanized coating designation.
   2. Thickness: Except as otherwise indicated, minimum 24 gauge. SMACNA recommendations shall govern.
   3. Finish: Kynar 500 or Hylar 5000 in color as selected by Architect from manufacturer's full range of custom colors.

C. Membrane Clad Sheet Steel:
   1. Commercial quality ASTM A527 with G-90 hot-dip galvanized coating designation.
   2. Thickness: Except as otherwise indicated, minimum 24 gauge. SMACNA recommendations shall govern.
   3. Finish: PVC coating as per Membrane Manufacturer’s requirements.

D. Sheet Lead:
   1. Comply with FS QQ-L-201, Grade B
      a. Four (4) pound minimum for use at roof drains and soil stacks.

E. Stainless Steel: ASTM A167, Type 302 / 304 Soft Temper, No. 2D finish. Minimum thickness 24 gauge, except as otherwise noted.

2.3 FASTENERS

A. Same metal as flashing / sheet metal or other non-corrosive metal or as noted below.

B. Exposed fasteners shall be self-sealing and gasketed (ZAC type) for weathertight installation.

C. Match finish of exposed heads with material being fastened.

D. Mechanical Fasteners:
   1. Nails: Ring shank, minimum 1-1/2 inches in length with 1/2 inch diameter head.
   2. Washers: Steel washers with bonded rubber sealing gasket.
   3. Screws: Self-tapping sheet metal type of stainless steel or compatible with material being fastened, with hooded integral EPDM washers (ZAC type).
   4. Rivets: Stainless steel and cadmium plated material, closed end type of sizes recommended by sheet metal manufacturer to suit application.

E. Clips:
   1. Cleat (coping / fascia): Minimum 22 gauge, G-90 galvanized, stainless steel, or aluminum. Match material of coping / fascia and provide one (1) gauge heavier.

2.4 RELATED MATERIALS

A. Solder: ASTM B32, alloy grade 58, 50 percent tin, 50 percent lead.

B. Flux:
   1. Phosphoric acid type, manufacturer’s standard.
      a. For Use with Steel or Copper: Rosin flux

b. For Use with Stainless Steel: Acid-chloride type flux, except use rosin flux over tinned surfaces.

C. Underlayment:
1. At expansion joints: to be used as bellow; 48 mil minimum, non-reinforced, homogeneous, waterproof, impermeable elastomeric sheeting manufactured by Nervastral, Inc. or Lexsuco.
2. At wood blockings: Self-Adhered Flexible Flashing: 40-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film. Provide compatible substrate primer as instructed by manufacturer and coordinate with specification 07 65 00.

D. Adhesives: Type recommended by flashing sheet manufacturer seaming and adhesive application of flashing sheet to ensure adhesion and watertightness.

E. Metal Accessories: Sheet metal clips, straps, anchoring devices, clamps and similar accessories required for the complete installation of work, matching or compatible with material being installed, non-corrosive, size and gauge recommended by installer to suit application and performance.

F. Sealant:
1. Type A:
a. Type: One-part, non-sag, moisture-curing polyurethane sealant.
b. Approved Products / Manufacturers: “Chem-Calk 900” manufactured by Bostik Construction Products Division, “Vulkem 921” manufactured by Mameco International, Inc., “Dynatrol I” manufactured by Pecora Corporation, “MasterSeal NP 1” manufactured by BASF, or approved equal.
2. Type B:
a. Type: One-part, neutral-curing, medium-modulus silicone sealant for sealing metal to metal surfaces, i.e. metal edge, cover plates, etc.
b. Approved Products / Manufacturers: “Chem-Calk 1200” manufactured by Bostik Construction Products Division, ”795 Silicone Building Sealant” manufactured by Dow Corning Corporation, “895 Silicone” manufactured by Pecora Corporation, “Omniseal” manufactured by Sonneborn Building Products, “Spectrem 2” manufactured by Tremco Incorporated, or approved equal.

G. Grout - Pitch Pans:
1. Type: Quick-setting, non-shrink, non-metallic, high strength formula complying with ASTM C1107.
2. Approved Products / Manufacturers: “Sure Grip High Performance Grout” manufactured by Dayton Superior Corporation, “Premier Quick-Trim” manufactured by L & M Construction Chemicals, Inc., “MasterFlow” manufactured by BASF, or approved equal.

H. Pitch Pan Filler:
1. Type: Pourable polyurethane sealer, approved by roofing system manufacturer.
2. Approved Products / Manufacturers: “Quick Pitch Sealer” manufactured by U.S. Intec, “SPM Pourable Sealer” manufactured by Johns Manville, or approved equal.

I. Termination Bar:
1. Material: Extruded aluminum bar with flat profile.
2. Size: 1/8 inch thick by one (1) inch wide with factory punched 1/4 inch x 3/8 inch oval holes spaced six (6) inches on center.

3. Approved Product / Manufacturer: “TB 125” manufactured by TruFast Corp., or approved equal.

J. Pipe Hangers and Supports: Refer to Section 07 72 00, Roof Accessories.

K. Splash Blocks: Concrete type, of size and profiles indicated; minimum 3,000 psi compressive strength at 28 days, with minimum five (5) percent air entrainment. Use at locations where roof drainage discharges on ground.

L. Splash Pans: 22 gauge stainless steel, of size and profiles indicated. Use at locations where roof drainage discharges over adjoining, lower roof level(s).

2.5 FABRICATION

A. Except as otherwise indicated, fabricate work in accordance with SMACNA Architectural Sheet Metal Manual and other recognized industry practices and reviewed shop drawings. Form all flashings, receivers and counterflashings in accordance with standards set forth in the NRCA roofing manual and SMACNA.

B. Comply with manufacturer's installation instructions and recommendations.

C. Shop fabricate Thru-wall, counterflashings, expansion joint metal and wind clips to greatest extent possible.

D. Fabricate items to size and dimensions as indicated on the drawings. Limit single-piece lengths to twelve (12) feet for prefabricated pieces and ten (10) feet for shop fabricated pieces.

E. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work sufficient to permanently prevent leakage, damage or deterioration of the work.

F. Integrate flashing in a manner consistent with membrane waterproofing detailing. Form work to fit substrates.

G. Make angle bends and folds for interlocking metal with full regard for expansion and contraction to avoid buckling or fullness in metal after installation.

H. Fabricated items will have straight lines, sharp angles, smooth curves, and true levels. Avoid tool marks, buckling, and oil canning.

I. Fold back edges on concealed side of exposed edge to form hem.

J. Unless noted otherwise, lap joints minimum three (3) inch. Lap joints to have sealant installed as per details, to maintain watertight condition, inside and outside corners and elevation changes to be riveted and soldered.

K. Seams:
1. Wherever possible, fabricate non-moving seams in sheet metal with flat-lock seams and end joints.
2. Pre-finished Galvanized Steel: Seal pre-finished metal seams with rivets and silicone sealant.
3. Metal Other than Aluminum: Tin edges to be seamed, form seams, and solder.

L. On Kynar 500 or Hylar 5000 pre-finished metal, surface sand metal flanges prior to applying any primers. Prime all metal in contact with bituminous material.

M. Backpaint all concealed metal surfaces with bituminous paint where expected to be in contact with cementitious materials or dissimilar metals.

N. Expansion Provisions: Where lapped or bayonet type expansion provisions in work cannot be used or would not be sufficiently waterproof or weatherproof, form expansion joints of intermeshing hooked flanges, not less than one (1) inch deep filled with mastic sealant concealed within joints.

2.6 FABRICATED ITEMS

A. Metal Flashings:
   1. Through Wall Receiver Tray: Minimum 24 gauge stainless steel formed in maximum ten (10) foot lengths, through wall receivers shall not extend past the face of the exterior veneer more than ¾".
   2. Counterflashings: Minimum 24 gauge prefinished steel, formed in maximum ten (10) foot lengths.

B. Wind Clips: Minimum 24 gauge stainless steel (or match material of counterflashing), one (1) inch wide by length to engage counterflashing a minimum of 1/2 inch. To be installed at all wall flashings and at curb flashing lengths longer than 5 feet.

C. Roof Penetrations:
   1. Umbrella Counterflashing: Two-piece construction of minimum 22 gauge stainless steel, fabricated in accordance with drawings or project requirements.
   2. Flashing Pans:
      a. 24 gauge stainless steel.
      b. Fabricate to provide installed minimum clear inside perimeter dimension of two (2) inches on each side of penetrating element.
      c. Fabricate pans to at least six (6) inches above the finished roof membrane and with 1/4 inch hem at top edge and with four (4) inch flanges. Round all corners of flange.
      d. Fabricate metal bonnets for all pans, NO EXCEPTIONS. Fabricate bonnets with metal compatible with metal to which bonnet is to be attached. On beams and other steel, weld in place bonnets fabricated from 1/4 inch steel plate. Draw band bonnets fabricated from 22 gauge stainless steel may be used on circular projections.

D. Metal Edge / Fascia:
   1. Perma-Tite System 200 Fascia for thermoplastic roof systems: Decorative metal fascia with continuous formed rail.
      1) Construction:
         a) Fascia metal gauge
            1) 24 gauge galvanized steel.
         b) Finish:
            1) Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of custom colors.
         c) Formed Rail: Shall be continuous 20 gauge galvanized steel at 12'-0" standard lengths with pre-punched slotted holes and 6" stainless steel springs at 4'-0" on center.
      2) Thermoplastic Version
         a) Model:
            1) FA-80 (8.25" Face)
         b) Performance:
            1) 20 year, 160 mph Wind Warranty.

2) Tested per ANSI / SPRI ES-1 FM 4435 Standard to a design pressure of 200 psf to comply with the International Building Code.
3) FM tested to a minimum FM 1-180 rating

E. Continuous Cleats (where applicable): Continuous strips, same material and profile, minimum one gauge heavier of item which cleats attach.

F. Vent Hoods, Sleeves, Penetration Flashings, and Accessories: Minimum 24 gauge stainless steel, or as shown or directed otherwise.

G. Angle Termination Bar: Aluminum pressure bar 1/8 inch x one (1) inch.

H. Vent Pipe Flashing: Four (4) pound lead. Provide proper size to fold down inside of pipe a minimum of one (1) inch.

I. Gutters / Downspouts / Collector Heads: Seal-Tite Industrial Gutter System by manufacturer.
1. Minimum 24 gauge pre-finished galvanized steel, formed in maximum twelve (12) foot lengths.
2. Verify gutter and downspout meets rainfall data as outlined in SMACNA.
3. Seal-Tite Industrial Gutter, including 2" Wide Gutter Straps 24" o.c., Wind Straps 6'-0" o.c.,1/8" Stainless Steel Pop Rivits, and #10 x 2" Stainless Steel Fasteners to be manufactured and supplied to suit profile and dimension of gutter and downspout by manufacturer.
4. 24 gauge galvanized steel, color to match gutter.
5. For Single Ply roofing systems: Drip Edge with Factory Applied Flashing (PVC).
6. 24 gauge galvanized steel with membrane manufacturer's coating.
7. End Caps, Downspout Outlets, Gutter and Downspout Straps, Support Brackets and joint fasteners to be manufactured to suit profile and dimension of gutter and downspout.
8. Install all anchoring devices as outlined in manufacturer literature.
9. Expansion Joints: Style 1 per manufacturer, locate every 50 linear feet.
10. Gutter Straps and Supports: Minimum 3 .100 inch thick Downspout straps: Strap type, like metal, match color.
11. Downspout straps: Strap type, like metal, match color.
12. Gutter Screen: .050" Aluminum with ¼" dia. perforations
13. Collect Heads: Minimum 24 gauge pre-finished galvanized steel. As outlined in SMACNA; Refer to Figure 1-25F and Figure 1-28 with alternate Section A-A.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify substrates are smooth and clean to extent required to perform sheet metal work.

B. Verify roof openings, curbs, pipes, sleeves, ducts or vents through roof are solidly set in place.

C. Verify that reglets, nailers, cants, and blocking to receive sheet metal are in place and free of concrete and soil.

D. Do not start work until conditions are satisfactory.

3.2 PREPARATION

A. Field measure site conditions prior to fabrication work.

B. Install starter and edge strips and cleats before starting installation.

3.3 INSTALLATION

A. Install sheet metal with lines, arises, and angles sharp and true, and plane surfaces free from objectionable wave, warp, or buckle. Exposed edges of sheet metal shall be folded back to form 1/4 inch hem on concealed side from view. Finished work shall be free from water retention and leakage under all weather conditions. Pre-fabricated corners or transitions are required at changes in direction, elevation, or plane and at intersections. Locate field joints not less than 12 inches, nor more than three (3) feet from actual corner. Laps shall be one (1) inch, riveted and soldered at following locations:
   1. Pre-fabricated corners;
   2. transitions;
   3. changes in direction, elevation, and plane; and
   4. at intersections.

B. Anchor units of work securely in place to prevent damage or distortion from wind or buckling. Provide for thermal expansion of metal units; conceal fasteners wherever possible; and set units true to line and level as indicated. Install work with laps, joints, and seams which are permanently watertight and weatherproof.

C. Install fabricated sheet metal items in accordance with manufacturer's installation instructions and recommendations and with SMACNA Architectural Sheet Metal Manual.
   1. Ensure approved fasteners are used throughout the project.

   2. Ensure fasteners are installed in manufacturer pre-punched holes on rails, extrusions, clips and cleats.

   3. Ensure sufficient amount of waterblock is applied where appropriate to prevent leaking under rails/extrusions. **Contractor is responsible for cleaning stained brick and remedying for total length of workmanship warranty if waterblock is not installed appropriately.**

D. Separations: Provide for separation of metal from dissimilar metal or corrosive substrates by coating concealed surfaces with zinc chromate, bituminous coating, or other permanent separation at locations of contact as recommended by manufacturer or fabricator. Do not use materials which are incompatible with roofing system.

E. Cleat: At exposed edges of perimeter edge, fascias, cap flashings, and where required, attach cleat with appropriate fasteners supplied by roof edge manufacturer. Install cleat so fascia extends a minimum of 1 inch below top of exterior wall finish.

F. Counterflashing:
   1. Do not use surface mount counterflashing except as noted in drawings.
   2. Set in through wall with receiver and spring lock counterflashing, as detailed in drawings and to NRCA roofing manual, SMACNA standards.
   3. Coordinate installation of through-wall flashing with the masonry contractor.
   4. Seal through-wall in conjunction with masonry wall waterproofing.
   5. Install wind clips 30 inches o.c. at all counterflashing over five (5) feet in length.

G. Pitch Pans, Metal Flanges:
1. Apply sealant under pitch pan or metal flashing flange at least 1/2 pound per linear foot.
2. Prime all metal flanges with asphalt primer prior to flashing installation.
3. Clean all projections enclosed in pitch pans in any manner suitable and coated with a rust inhibitive coating as approved by the Architect. Coating shall be allowed to dry prior to pitch pan fill.
4. Fill base of pitch pans with grout or cementitious binder and allow to cure.
5. Top Finish Fill: Self-leveling, one-part urethane; at least two (2) inches to top of pitch pan sides.

H. Sanitary Vent Stacks:
1. Prime top and bottom flanges of lead flashing sleeve. Set flange in uniform troweling of plastic roof cement. Prime top side of flange to receive strip-in membrane.
2. Fold lead sleeve down inside of pipe a minimum of one (1) inch. Apply a continuous bead of sealant on inside of pipe prior to folding lead sleeve.

I. Gutters / Downspouts:
1. Install gutters as detailed.
2. Install downspouts plumb and level, attached to columns or wall with straps located at top and bottom of downspout and maximum ten (3) feet on center (note: 3 per 12' lengths supplied by manufacturer.
3. Install splash pad or block under discharge port of downspouts (if non exist). Install splash pan over a protection (walkway) pad for downspouts located at roof level.

3.4 CLEANING AND PROTECTION

A. Remove flux and residual acid immediately by neutralizing with baking soda and washing with clean water. Leave work clean of stains.

B. Remove scraps and debris and leave work area clean.

C. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes. Paint areas where finish is damaged on pre-finished metal by painting with a compatible paint in color to match undamaged finish.

D. Prime soldered area of phosphatized metal after cleaning to prevent rusting.

E. Paint metal flashings that have been soiled with bitumen with aluminized paint.

F. Clean other work damaged or soiled by Work of this Section.

G. Protect finished work from damage.

END OF SECTION 07 62 00

SECTION 07 65 00 - FLEXIBLE FLASHING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

B. Provide flexible flashing where shown on drawings or required.

1.3 RELATED SECTIONS

A. Section 04 20 00 – Unit Masonry
B. Section 07 26 20 – Fluid Applied Air Barrier System
C. Section 07 54 23 – Fully Adhered Thermoplastic Membrane Roofing System

1.4 SUBMITTALS

A. Product Data:
   1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
   2. Manufacturer's installation instructions.

B. Certification: Manufacturer's affidavit that materials used in Project contain no asbestos.

C. Compatibility: Submit letter from primary Fluid Applied Air Barrier System Manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from Manufacturer stating that cleaning materials used during installation are chemically compatible with adjacent materials proposed for use.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

A. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Flexible flashing materials used shall be compatible with and not void any warranties of the air barrier system used. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.2 MATERIALS

A. Flashing:
   1. Copper Laminated Flashing:
      a. Flashing: A full sheet of copper weighing five (5) ounces per square foot coated or bonded on both sides with one (1) of the following:
         1) Modified asphalt compound coated.
         2) Asphalt saturated, waterproof glass fiber laminated fabric.
      b. Approved Manufacturers:
         1) Advanced Building Products, Inc.
         2) Hohmann & Barnard, Inc.
         3) Sandell Manufacturing Company, Inc.

4) York Manufacturing, Inc.

c. Mastic: Manufacturer recommended asphalt troweled mastic for sealing copper laminated flashings

2. Asphalt-free Copper Fabric Flashing (Contractor's Option – in lieu of item above):
   a. Glass fabric scrim bonded to a full sheet of copper for general thru-wall flashing as an alternative to asphalt coated copper specified above and where sealant compatibility is required. Provide manufacturers approved seam tape.
   b. Approved Product/Manufacturer: Multi-flash 500 as manufactured by York Manufacturing, Inc.; or Copper-Tuff as manufactured by Hohmann & Barnard, Inc. (No substitutions)

3. Membrane Flashing:
   a. Self-Adhered Flexible Flashing: 40-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film. Provide compatible substrate primer as instructed by manufacturer.
   b. Approved Products / Manufacturers:
      1) "TW-Thru Wall Flashing" manufactured by Tamko Waterproofing.
      2) "Perm-A-Barrier" manufactured by W. R. Grace & Co.
      3) "Blueskin TWF" manufactured by Henry Co.
      4) "Bitu-Rap" manufactured by Nervastral, Inc.
      5) "Air-Shield" manufactured by W.R. Meadows, Inc.
      6) "AquaFlash 500" manufactured by Fiberweb.
4. Substrate Primer: as instructed by membrane manufacturer
5. Termination Bar: 1/8 inch thick by 1 inch minimum wide stainless steel, w/ pre-punched holes and self-tapping screws.
6. Weathering Flange at Door / Window Openings: Provide a 20 gauge (0.040") stainless steel or .040 aluminum 2"x3" weathering flange at head, jamb and under sill pan of storefront window and hollow metal door systems. Screw into wood blockings or substrate walls and strip into air barrier system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Flashing:
1. Follow manufacturer's instructions for mechanically fastened installation with a termination bar.
2. Application Guidelines - Install flashing at the following locations:
   a. Membrane Flashing: material transitions inside exterior cavity walls, roof edge / exterior wall transitions, masonry joints (control/expansion) inside exterior cavity walls, exterior door and window frame perimeters, roof deck / exterior wall transitions, exterior wall penetrations (i.e. pipe, conduit, ducts, etc.). Provide membrane at all joints, holes, gaps, or openings to ensure a continuously sealed building envelope. Utilize primer on substrates as instructed by manufacturer.
   b. Copper Flashing: At all horizontal wall flashing, including (but not limited to) exterior wall sill / weep conditions, exterior door and window head / weep conditions, intermediate and / or shelf angles, masonry wall cap flashing and masonry wall base flashing.
3. Apply substrate primer as instructed by membrane manufacturer to suit condition.

4. Provide drip edge flashing at weep conditions with membrane flashing. Cut ¼" to ½" behind with outside edge of brick over top of drip edge flashing to alleviate exposure to UV degradation and deterioration of asphalt membrane.
5. On Horizontal Surfaces: The flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches. Flashing will then be secured in back wall with termination bar.
6. On Vertical Surfaces: Surfaces receiving the flashing shall be sufficiently spotted with asphalt mastic to hold in place until masonry is set. Secure in back wall with termination bar.
7. Foundation Sill Dampproofing: The flashing for foundation sills shall be laid in a slurry of fresh mortar or in a full bed of mastic and topped with a fresh full bed of mortar. The flashing shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be sloped across the cavity and turned up the wall a minimum of ten (10) inches and secured to back wall with termination bar. Where sill and column meet, flashing shall be brought up a minimum of ten (10) inches up the column.
8. Thru-Wall Flashing: Shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Carry flashing through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secure in back wall with termination bar.
9. Cavity Wall: Flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secured in the back wall with termination bar. Vertical membrane joints shall be secured with termination bar as instructed by membrane manufacturer.
10. Heads, Jambs and Sills: Flashing for heads and sills shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise. Head flashing shall be carried six (6) inches beyond both end of the steel lintel. Both head and sill flashing shall be turned up at the sides to form a pan. All corners shall be folded, NOT CUT. Jambs are to be turned into the buildings to complete seal perimeter of window or door. Install weepholes.
11. Wood blockings: Flexible flashings are to cover wood blockings in their entirety.
12. Spandrels: Spandrel flashing shall start from the outside toe of the shelf angle, go up the face of the beam and then through the wall, turned up on the inside not less than two (2) inches. Install weepholes.
13. Parapet or Coping: Flashing for parapets or coping sills shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Weepholes shall be installed immediately on top of the flashing.
14. Lengths: Install flashings without longitudinal joints within walls, if possible. If required materials are not available in a single width, join by lapping material minimum two (2) inches and seal joint throughout its length with adhesive.
15. End Joints: Avoid end joints in flashing. When end joints are necessary, lap flashing minimum six (6) inches and seal joint continuously with adhesive.
16. Penetrations: Where anchors, pipes, and inserts penetrate flashing, make opening in flashing snug and seal with adhesive.
17. Reglet Termination: Insert wedge into place and seal carefully with adhesive.

18. Termination Bar: Install flashing with termination bars in accordance with manufacturer's instructions. Provide 3 coursing at all termination bars, typical.
19. Top Coat: After flashing material is in place (except in masonry joints where bond and mortar is required) trowel full 1/8 inch protective coating or mastic on all flashing faces.

B. Bed Joints: Coordinate work with Division 4, Masonry. Install thru-wall flashings between two (2) thin layers of masonry mortar without increasing thickness of mortar joint. Keep outer edge of flashing material back 3/4 inch from face of masonry.

3.2 APPLICATION

A. Protect membrane from overexposure to direct sunlight.

B. Follow manufacturer’s recommendations for installation.

C. Adjacent Work: Protect work by masking, covering, or other precautionary methods. Remove protection when no longer necessary.

END OF SECTION 07 65 00

SECTION 07 72 00 - ROOF ACCESSORIES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 INSTALLATION RESPONSIBILITY

A. In addition to the items normally a part of this Section, coordinate the installation of roof accessory curbs and pipe flashings and equipment supports that may be specified elsewhere.

B. Coordinate the Work specified herein with the following Work:
   1. Roofing
   2. Roofing sheet metal
   3. Mechanical equipment
   4. Plumbing

1.2 REFERENCES

A. Federal Specifications (FS)
   1. TT-S-00227E

B. National Roofing Contractors Association (NRCA)

C. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
   1. Architectural Sheet Metal Manual

1.3 SUBMITTALS

A. Product Data: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

B. Shop Drawings: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

1.4 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 13 – Project Coordination.

1.5 WARRANTY

A. Warranty the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

B. Defects shall include, but not be limited to, the following:
   1. Noticeable deterioration of finish
   2. Leakage of water into the building or within the construction.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Specifications are based on products of named manufacturers. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.2 PREFABRICATED ROOF CURBS

A. Frames:
   1. Material: ASTM A 653 G90 hot-dipped galvanized steel.
      a. Minimum 18 gauge, and as engineered by manufacturer.
      b. Minimum 18 gauge for curbs supporting HVAC units
      c. Minimum 20 gauge for expansion joint curbs.
   2. Corners: Mitered and welded (welds are micro sealed and prime painted after fabrication). Bolted connections not accepted.
   3. Base Plates: Integral to frame and welded.
   4. Internally reinforced with galvanized 1 inch by 1 inch by 12 gauge angles for curbs exceeding 3 foot length. Reinforce internal bulkhead at equipment curbs to support lateral loads.
   5. Wood Nailers: Factory installed, pressure treated. Size and width as suitable for support of items installed on curbs.

B. Insulation: Factory installed 1-1/2 inch thick three-pound density fiberglass insulation.

C. Curb Height: Minimum 8 inch above finished roof.

D. Construct curbs to match roof slope with plumb and level top surface for mounting mechanical equipment.

E. Gasketing: 1/4 inch thick, one (1) inch wide at roof top units.

F. Counterflashing: 24 gauge stainless steel

G. Counterflashing Cap: Stainless steel.

H. Cants:
   1. Non-canted curb style installs either under or on top of metal decks with insulation.
   2. Cants shall be provided under Section 07 52 19 - Roofing

I. All insulated roof curbs shall be structural and shall include calculations signed and sealed by a registered Structural Engineer. Refer to installation drawings for any additional structural requirements. If curbs do not span a minimum of two bar joists, only two angles will be required. Coordination mechanical equipment weight loading on the roof with Structural Engineer.

J. Approved Manufacturers:
   1. Custom Curb, Inc.
   2. Roof Products, Inc.

2.3 PIPE SUPPORTS (Cannot be contractor built supports)

A. Gas Pipe Supports:
1. Provide strut and hanger type support with recycled plastics and carbon black for UV protection bases (10 inches x 16 inches x 3 inches; 6 lbs. each); Model Type PP-10 with strut & hanger for lines 2-1/2 inches and smaller, Model Type PS-1-2 with hanger for lines 3 inches and larger.
2. As manufactured by PHP Systems Design; Miro Industries Inc.; MAPA Products; Advanced Support Products or Architect approved equal.

B. Electrical Conduit / Condensate Lines:
1. Provide strut type support with recycled plastics and carbon black for UV protection bases (10 inches x 16 inches x 3 inches; 6 lbs. each), install with hold clips ordered as an accessory; Model Type PP-10 with strut. Model Type PS-1-2 with hanger for lines 3 inches and larger.
2. As manufactured by PHP Systems Design; Miro Industries Inc.; MAPA Products; Advanced Support Products or Architect approved equal.

C. Chill Water Lines:
1. Provide strut and hanger type support with recycled plastics and carbon black for UV protection bases (size as required); Model Type PS-1-2 and Model Type PSE-2-2 as required.
2. As manufactured by PHP Systems Design, Inc.; Miro Industries Inc.; MAPA Products; Advanced Support Products or Architect approved equal.

D. Installation:
1. Locate as indicated by Drawing at no greater than 8 feet-0 inches o.c.
2. Provide protective traffic pads below each support, tacked in place with approved mastic or adhesive.
3. Install hold down clips if indicated on the drawings or required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof accessories in accordance with manufacturer's printed instructions and approved shop drawings. Installation of Portable Pipe Hangers shall not exceed six (6) feet on center.

B. Coordinate with roofing operation for watertight integrity.

C. Finished installation shall be water and air tight. Install sealant conforming to FS TT-S-00227E, Type II, Class A.

END OF SECTION 07 72 00

SECTION 07 84 00 - FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Penetration firestop systems.
   2. Fire resistive joint systems.
   3. Repair of firestop assemblies disturbed by the work.
   4. Smoke barriers.
   5. Accessories necessary for a complete installation.

1.3 PERFORMANCE REQUIREMENTS

A. Penetration Fire Resistance Systems:
   1. For penetrations through vertical and horizontal fire resistance rated constructions, including both empty openings and openings containing penetrating items, provide firestop systems produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and gases, and maintain original fire resistance rating of construction penetrated.
   2. Rated Systems: Provide penetration firestop systems with ratings determined in accordance with UL 1479 for C-AJ, C-BJ, C-BK, F-A, F-B, F-C, W-J, W-K, and W-L classified systems.
      a. F Rated Systems: Provide penetration firestop systems with F ratings indicated, but not less than that equaling or exceeding fire resistance rating of constructions penetrated.
      b. T Rated Systems: For specified conditions, provide penetration firestop systems with T ratings indicated, as well as F ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas.
      c. L Rated Systems: Where penetration firestop systems are indicated in smoke barriers, provide penetration firestop systems with L ratings of not more than 3.0 cfm/sq. ft (0.01524cu. m/s x sq. m) at both ambient temperatures and 400 degrees F (204 degrees C).
      d. For penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to conditions both during and after construction.
      e. For piping penetrations for plumbing and wet pipe sprinkler systems, provide moisture resistant penetration firestop systems.
      f. For penetrations involving insulated piping, provide penetration firestop systems not requiring removal of insulation.

   3. For penetration firestop systems exposed to view, provide products with flame spread and smoke developed indexes of less than 25 and 450, respectively, determined in accordance with ASTM E 84.

B. Fire Resistive Joint Systems: System produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and gases, and maintain original fire resistance rating of assembly in which fire resistive joint systems are installed.

1. Joint Systems in and between Fire Resistance Rated Constructions: Provide systems with assembly ratings equaling or exceeding fire resistance ratings of construction that are join, with movement capabilities and L ratings] indicated determined by UL 2079.
2. Perimeter Fire Resistive Joint Systems: For joints between edges of fire resistance rated floor assemblies and exterior curtain walls, provide systems of type and with ratings indicated determined by NFPA 285 and UL 2079.
3. For fire resistive systems exposed to view, provide products with flame spread and smoke developed indexes of less than 25 and 450, respectively determined in accordance with ASTM E 84.

1.4 SUBMITTALS

A. Product Data: Technical data including installation recommendations, construction conditions, applicable UL assemblies.

B. Shop Drawings: For each penetration firestop or fire resistive joint system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetration. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.
   1. Submit documentation, including illustrations, from qualified testing and inspecting agency, applicable to each firestop system configuration for construction and penetrating items.

C. Product Certificates: For penetration firestop system products, signed by product manufacturer.

D. Product Test Reports: From a qualified testing agency indicating penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Building Code: Comply with applicable requirements of the IBC and the fire code.
   2. Fire Test Response Characteristics: Provide firestop systems complying with requirements:
      a. Penetration Firestopping: Penetration firestop systems are identical to those tested in accordance with UL. Provide rated systems complying with requirements.
         1) Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
         2) Penetration firestop system products bear classification marking of qualified testing and inspecting agency.
         3) Penetration firestop systems correspond to those indicated by reference to penetration firestop system designations listed by UL in its *Fire Resistance Directory* and FM Global in its *Building Materials Approval Guide*.

      b. Fire Resistive Joints: Perform fire resistance tests by UL with follow up inspection services for fire resistive joint systems acceptable to authorities having jurisdiction.
         1) Fire resistive joint system products bear classification marking of qualified testing and inspecting agency.
         2) Fire resistive joint systems correspond to those indicated by reference to penetration firestop system designations listed by UL in its *Fire Resistance Directory*.

B. Installer Qualifications: A firm experienced in installing firestop systems and who has been approved by FM Global according to FM Global 4991 *Approval of Firestop Contractors* or been evaluated by UL and found to comply with UL *Qualified Firestop Contractor Program Requirements* and has minimum 5 years documented experience in installing firestopping assemblies

1. Manufacturer's willingness to sell its penetration firestop system products to Contractor or to Installer engaged by Contractor does not qualify buyer/installer.

C. Installation Responsibility: Assign installation of penetration firestop systems and fire resistive joint systems to a single qualified installer.

D. Source Limitations: Obtain firestop systems, for each kind of penetration and construction condition indicated, one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver firestop system products to site in original, unopened containers or packages with intact and legible manufacturer labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install firestop systems when ambient or substrate temperatures are outside limits permitted by firestop system manufacturer or when substrates are wet due to rain, frost, condensation, or causes.

B. Install and cure fire resistive joint systems in accordance with manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced air circulation.

C. Ventilate firestop systems per manufacturer's written instructions by natural means or, where inadequate, forced air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that firestop resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core drilled holes, or cut openings to accommodate penetration firestop systems.

C. Joint System: Coordinate sizing of joints to accommodate fire resistive joint systems.

D. Do not cover up penetration firestop system or fire resistive joint system installations that will become concealed behind other construction until building inspector of authorities having jurisdiction have examined each installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturer: Subject to compliance with requirements, provide firestop systems by one of the following for each application required:
1. Hilti, Inc.
2. Nelson Firestop Products.
3. RectorSeal Corporation (The).
4. Specified Technologies Inc.

5. 3M; Fire Protection Products Division.
6. USG Corporation.
7. Tremco Commercial Sealants and Waterproofing.

B. Compatibility: Provide firestop systems compatible with each other; with substrates forming openings; and with items penetrating penetration firestop systems, under conditions of service and application, demonstrated by penetration firestop system manufacturer based on testing and field experience.

C. Accessories: Provide components for each firestop system necessary to install fill materials. Use components specified by penetration firestop or fire resistive joint system manufacturer and UL. Accessories include, but are not limited to:
   1. Penetration Firestop Systems: Provide penetration firestopping produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and gases, and maintain original fire resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with substrates forming openings, and with penetrating items if any.
   2. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
      a. Permanent forming/damming/backing materials, including the following:
         1) Slag wool fiber or rock wool fiber insulation.
         2) Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
         3) Fire rated form board.
         4) Fillers for sealants.

      b. Temporary forming materials.
      c. Substrate primers.
      d. Collars.
      e. Steel sleeves.

D. Fill Materials: Penetration firestop systems containing types of fill materials indicated. Fill materials are those referenced in directories of referenced testing and inspecting agencies as *fill, void,* or *cavity* materials.
   1. Cast in Place Firestop Devices: Factory assembled devices for use in cast in place concrete floors and consisting of an outer metallic sleeve lined with intumescent strip, radial extended flange attached to one end of sleeve for fastening to concrete formwork, and neoprene gasket.
   2. Latex Sealants: Single component latex formulations that after cure do not reemulsify during exposure to moisture.
   3. Firestop Devices: Factory assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
   4. Intumescent Composite Sheets: Rigid panels consisting of aluminum foil faced elastomeric sheet bonded to galvanized steel sheet.
   5. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
   6. Intumescent Wrap Strips: Single component intumescent elastomeric sheets with aluminum foil on one side.
   7. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at site to form nonshrinking, homogeneous mortar.
   8. Pillows/Bags: Reusable heat expanding pillows/bags consisting of glass fiber cloth cases filled with combination of mineral fiber, water insoluble expansion agents, and fire retardant additives.

9. Silicone Foams: Multicomponent, silicone based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
10. Silicone Sealants: Single component, silicone based, neutral curing elastomeric sealants of grade indicated.
    a. Grade: Pourable (self-leveling) formulation for openings in floors and horizontal surfaces, and nonsag formulation for openings in vertical and surfaces requiring nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.

E. Fire Resistive Joint Systems: Sealants complying with UL 1479 including F, T, and L ratings.

F. Fire Safing Insulation:
1. Semirefractory Blanket: Semirigid blankets designed for use as fire stops at openings between edge of slab and exterior wall panels, glass mat faced, low density; having nominal density of 4 lb/cu. ft. (64 kg/cu. m); complying with ASTM C 612, Type 1A and 1B and ASTM E 136 for combustion characteristics; thermal resistivity of 4 degrees F x h x sq. ft./Btu x in. at 75 degrees F (27.7 K x m/W at 24 degrees C).; with maximum flame spread and smoke developed values of 10 and 5. Use for floor perimeter fire and smoke containment. Install blanket with 20 gauge impaling clips recommended by manufacturer.
2. Caulking Compound: Material approved by manufacturer of safing insulation for sealing joint between foil backing of safing insulation and edge of concrete floor slab against penetration of smoke.
3. Safing Clips: Galvanized steel safing clips approved by manufacturer of safing insulation for holding safing insulation in place.

G. Duct Wrap for Ducts: Materials listed in the UL Fire Resistance Directory under File R8418, Category CAJ7009, File R14229 Categories CAJ 7013, CAJ 7015, CAJ 7020, CAJ 7022, YYET, and Grease Duct Enclosures and having minimum 2 hour fire resistive rating for grease or air duct enclosure materials.

H. Composition Edge Banding: Materials listed in UL Fire Resistance Directory UL 10c standard.

2.2 FIRE STOPPING SYSTEMS

A. Penetration System:
1. Penetrations in Fire Resistance Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
    a. Fire resistance rated walls include fire walls, fire barrier walls, smoke barrier walls, and fire partitions.
    b. F Rating: Minimum fire resistance rating of constructions penetrated.

2. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
    a. Horizontal assemblies include floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.
    b. F Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
    c. T Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

3. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
    a. L Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at 0.30 inch wg (74.7 Pa) at both ambient and elevated temperatures.

b. W Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.

4. Exposed Penetration Firestopping: Provide products with flame-spread and smoke developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

B. Joint Resistive Systems:
1. Joints in Smoke Barriers: Provide fire resistive joint systems with ratings determined per UL 2079.
a. L Rating: Not exceeding 5.0 cfm/ft (0.00775 cu. m/s x m) of joint at 0.30 inch wg (74.7 Pa) at both ambient and elevated temperatures.

2. Exposed Fire Resistive Joint Systems: Provide products with flame-spread and smoke developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
3. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

2.3 MIXING

A. For products requiring mixing before application, comply with penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for opening configurations, penetrating items, substrates, and conditions affecting performance of work. Proceed with installation after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing penetration firestop systems complying with firestop system manufacturer's written instructions and with the following requirements:
1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form release agents from concrete.

B. Priming: Prime substrates where recommended in writing by penetration firestop system manufacturer complying with manufacturer's recommended. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of work and that would be permanently stained or damaged by contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 INSTALLATION

A. Penetration Firestop System: Install penetration firestop systems to comply with requirements and with firestop system manufacturer written installation instructions and published drawings for products and applications indicated.
   1. Install forming/damming/backing materials and accessories of types required to support fill materials during application and in the position needed to produce cross sectional shapes and depths required to achieve fire ratings indicated. After installing fill materials and allowing them to fully cure, remove combustible forming materials and accessories not indicated as permanent components of firestop systems.
   2. Install fill materials for firestop systems by proven techniques to produce results:
      a. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire resistance ratings indicated.
      b. Apply materials for full contact and adhere to substrates formed by openings and penetrating items.
      c. For fill materials that remain exposed after completing work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

B. Fire Resistive Joint System: Install fire resistive joint systems to comply requirements and manufacturer's written installation instructions for products and applications indicated.
   1. Install forming/packing/backing materials and accessories of types required to support fill materials during application and in position needed to produce cross sectional shapes and depths required to achieve fire ratings indicated.
   2. Install fill materials for joint systems by proven techniques to produce the following results:
      a. Fill voids and cavities formed by openings and forming/packing/backing materials required to achieve fire resistance ratings indicated.
      b. Apply fill materials to contact and adhere to substrates formed by joints.
      c. For fill materials remaining exposed after completing work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of edge of the firestop systems so labels are visible at removal.
   1. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces and, in combination with label material, resulting in partial destruction of label if removal is attempted. Include information on labels:
      a. The words *Warning - Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage*.
      b. Contractor's name, address, and phone number.
      c. Firestop system designation of applicable testing and inspecting agency.
      d. Date of installation.
      e. Penetration firestop system manufacturer's name.
      f. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or fire resistive joint systems are damaged or removed due to testing, repair or replace fire resistive joint systems so they comply with requirements.

C. Proceed with enclosing fire resistive joint systems with construction after inspection reports are issued and installations comply with requirements.

3.6 CUTTING AND PATCHING

A. Cut, patch, and repair firestopping to accommodate work. Repair cracks and indented surfaces. Repair surfaces around items built into or penetrate surfaces. Repair and replace work to eliminate blister, buckles, dry outs, and similar imperfections. Repair and replace work required to comply fire resistance ratings.

B. After completion of work in and around the areas of firestopping, repair and replace damaged firestopping.

3.7 CLEANING AND PROTECTION

A. Clean excess fill materials adjacent to openings as work progresses by methods and with cleaning materials approved in writing by penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation ensuring penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestop systems immediately and install new materials to produce systems complying with requirements.

END OF SECTION 07 84 00

SECTION 07 92 00 – JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Control and expansion joints on exposed surfaces.
   2. Perimeter joints between wall surfaces and frames of doors and openings.
   3. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   4. Joints indicated or as necessary.
   5. Accessories necessary for a complete installation.

1.3 RELATED SECTIONS

A. Section 04 20 00 – Unit Masonry.

B. Section 04 21 00 – Clay Unit Masonry.

C. Section 04 22 00 – Concrete Unit Masonry.

D. Section 08 80 00 – Glazing.

E. Section 09 30 13 – Ceramic Tiling.

F. Section 09 30 16 – Porcelain Tiling.

1.4 SUBMITTALS

A. Product Data: Technical data for each joint sealant product. Submit written certification from manufacturers of sealants attesting products are suitable for use indicated, verified through in house testing laboratory.
   1. Written certification from manufacturers of joint sealants attesting that products comply with specification requirements and suitable for use indicated verified through manufacturers testing laboratory within the past 36 months or since most recent reformulation, whichever is most recent.
      a. Complete instructions for handling, storage, mixing, priming, installation, curing and protection of each type of sealant.
      b. Manufacturer's letter, clearly indicating proposed lot numbers of each sealant supplied and expiration date sequence.
      c. Instructions for handling, storage, mixing, priming, installation, curing, and protection of each type of sealant.

   2. Recycled Content:
      a. Indicate recycled content; indicate percentage of preconsumer and postconsumer recycled content per unit of product.
      b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.

c. If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
d. If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.

3. Local/Regional Materials:
   a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
   b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
   c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
   d. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

4. VOC Data: Submit manufacturer's product data for sealants. Indicate VOC limits of the product. Submit MSDS highlighting VOC limits.
5. Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under work of this Section.

B. Certificates and Reports:
1. Product Certificates: Manufacturer's product certificate for each kind of joint sealant and accessory.
2. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
3. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
4. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
   a. Materials forming joint substrates and sealant backings have been tested for compatibility and adhesion with sealants.
   b. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

5. Preconstruction Field Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified.
6. Field Adhesion Test Reports: For each sealant application tested.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Firm having minimum 5 years documented experience and specializing in the installation of sealants.
1. Exposed sealant work (sealants used for air and weatherseals external to curtain wall systems at perimeter, metal panel to panel joints) shall be performed by a single (i.e. one) firm specializing in the installation of sealants who has successfully produced work comparable to project.
2. Concealed sealant work (sealants which are internal to metal framed curtain wall systems, skylights, and providing an air seal) shall be the responsibility of the subcontractor providing erection of the respective system.

B. Source Limitations: Obtain each type of joint sealant from a single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
2. Test according to SWRI Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion in peel, and indentation hardness.

D. Environmental Requirements:
1. Toxicity/IEQ: Comply with applicable regulations regarding toxic and hazardous materials.
   a. VOC Content of Interior Sealants: Sealants and sealant primers complying with limits for VOC content for SCAQMD when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
      1) Sealants: 250 g/L.
      2) Sealant Primers for Nonporous Substrates: 250 g/L.
      3) Sealant Primers for Porous Substrates: 775 g/L.

   b. Sealants containing aromatic solvents, fibrous talc, formaldehyde, halogenated solvents, mercury, lead, cadmium, chromium and their compounds, are not permitted.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturer written instructions to prevent deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 degrees F (4.4 degrees C).
2. When joint substrates are wet. Should joints or backing materials become wet, remove and replace backing material with new.

B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 WARRANTY

A. Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealant work which has failed to provide a weathertight system within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

B. Warranties: Written warranties (weatherseal and stain resistance), signed by sealant manufacturer agreeing to furnish joint sealants to repair or replace those that fail to provide airtight and watertight joints, or fail in adhesion, cohesion, abrasion resistance, stain resistance,

weather resistance, durability, or appear to deteriorate in manner not specified in the manufacturer's data as an inherent quality of the material within specified warranty period.

1. Warranty Period: 5 years from date of Substantial Completion.

C. Warranties specified exclude deterioration or failure of sealants from:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Compatibility: Provide joint sealants, backings, and related materials compatible with one another and with joint substrates under conditions of service and application, as stated by sealant manufacturer’s published data, and as substantiated by the manufacturer for each application through testing.

B. Liquid Applied Sealants: Comply with ASTM C 920 and requirements indicated for each liquid applied sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

C. Stain Test Response Characteristics: For sealants in contact with porous substrates, provide nonstaining products that have undergone testing according to ASTM C 1248 and do not stain porous joint substrates.

D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

E. Colors: For fully concealed joints, provide standard color of sealant that has the best overall performance characteristics for the application shown. For exposed joints, match adjacent surface. For exposed joints, submit color samples to architect for approval, from manufacture’s full line of standard colors.

F. Manufacturer’s Representative: Use sealant produced by manufacturer who agrees to send a qualified technical representative to site upon request for the purpose of rendering advice concerning the recommended installation of manufacturer’s materials.

G. Sealants: Self leveling compounds for horizontal joints in pavements and nonsag compounds elsewhere except as shown or specified.

H. Silicone Sealant: Comply with ASTM C920, Type M, Grade NS, Class 25; use NT, M, A and O.

1. Use: Precast Concrete Joints between metals, glass and plastics (Two part silicone sealants).
2. Properties: Performance: Nonstain, nonbleed, nonstreaking to sealed and adjacent substrates. The minimum pli value after 7 day immersion shall not be less than 13 when tested in strict accordance with ASTM C794 Adhesion and Peel.
3. Cure System and Oil Content: Neutral Cure System specifically manufactured with controlled oil content to eliminate oil migration into sealed substrates and residue rundown over and onto adjacent substrates.

4. Product and Manufacturer: Dow Corning; 756 Silicone Building Sealant - HP with Additive.

I. Silicone Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.
   1. Use: Precast Concrete Joints between metals, glass and plastics (Single component sealants).
   2. Properties: Performance: Nonstain, nonbleed, nonstreaking to sealed and adjacent substrates.
   3. Cure System and Oil Content: Neutral Cure System specifically manufactured with controlled oil content to eliminate oil migration into sealed substrates and residue rundown over and onto adjacent substrates.
   4. Product and Manufacturer:
      a. BASF Building Systems; Omniseal 50.
      b. Dow Corning Corporation; 756 SMS, 791, 795, 995 as applicable.
      c. GE Advanced Materials, Silicones; SilGlaze II SCS2800, SilPruf NB SCS9000, SilPruf SCS2000, or UltraPruf II SCS2900 as applicable.
      d. Sika Corporation, Construction Products Division; SikaSil-C995.

J. Polyurethane Sealants: ASTM C920, Type M, Grade NS, Class 25; use NT, M, A and O.
   1. Use: Typical Wall and Floor Joints (Two part polyurethane sealants).
   2. Properties: Performance: Nonstain, nonbleed, nonstreaking to sealed and adjacent substrates.
   3. Products and Manufacturers:
      a. BASF Building Systems; MasterSeal NP 2.
      b. Pecora Corporation; Dynatred.
      c. Sika Corporation, Construction Products Division; Sikaflex 2c NS or Sikaflex 2c NS TG as applicable.

K. Two Part Polyurethane Sealants: ASTM C920, Type M, Grade NS, Class 50; use NT, M, A and O.
   1. Use: Typical Wall and Floor Joints (Two Part Polyurethane Sealants).
   2. Properties: Performance: Nonstain, nonbleed, nonstreaking to sealed and adjacent substrates. The minimum pli value after 7 day immersion shall not be less than 13 when tested in strict accordance with ASTM C794 Adhesion in Peel.
   3. Products and Manufacturers: One of the following:
      a. Schnee-Morehead, Inc.; Permathane SM 7200.
      b. Sika Corporation, Inc.; Sikaflex - 2c NS TG.
      c. BASF Construction Chemicals; NP 2.

L. Mildew Resistant Silicone Sealant: ASTM C920, Type S, Grade NS, Class 25, Use NT, Substrate uses G, A, and O; and containing fungicide for mildew resistance; acid curing.
   1. Use: Joints at toilet fixtures, toilet room countertops and vanities, wet areas, and janitor closet mop receptor to wall transition.
   2. Products: Provide one of the following:
      a. BASF Building Systems; Omniplus.
      b. Dow Corning; 786 Mildew Resistant Silicone Sealant.
      c. GE Silicones; Sanitary SCS 1700.

M. Latex Sealant: Nonelastomeric, one part, nonsag, paintable latex sealant that is recommended for exposed applications on the interior. Complying with ASTM C 834, Type OP (opaque sealants):
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Pecora Corporation; AC-20 + Silicone.
      b. BASF; MasterSeal.

N. Acoustical Joint Sealant: Nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Pecora Corporation; AC-20 FTR or AIS-919.
      b. USG Corporation; SHEETROCK Acoustical Sealant.

O. Sealant Backing: Provide sealant backings that are nonstaining; compatible with joint substrates, sealants, primers, and joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
   1. Cylindrical Sealant Backings: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding backings of flexible plastic foam complying with ASTM C 1330, and of type indicated below. Select shape and density of cylindrical sealant backings in consultation with the manufacturer for proper performance in specific condition of use in each case.
   2. Type C: Closed cell polyethylene foam material with surface skin, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state; one of the following:
      a. HBR Closed Cell Backer Rod; Nomaco, Inc.
      b. MasterSeal 920 Closed-Cell Backer-Rod; BASF Construction Chemicals.

P. Miscellaneous Materials:
   1. Primer: Material recommended, as verified through compatibility and adhesion testing, by joint sealant manufacturer for the substrates indicated to be sealed.
   2. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.
   3. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and which will not stain nor mar the finish of surface adjacent to joints to which it is applied.
   4. Cork Joint Filler: Resilient and nonextruding, ASTM D1752, Type II.
   5. Bond Breaker Tape: Polyethylene, TFE fluorocarbon, or plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants for compliance with requirements for joint configuration, installation tolerances, and conditions affecting sealant performance. Proceed with installation after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with the recommendations of joint sealant manufacturer and requirements:
   1. Remove foreign material from joint substrates interfering with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), existing joint sealants, oil, grease, water, surface dirt, and frost.
   2. Clean concrete, masonry, unglazed surfaces of tile and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil free compressed air.

3. Remove laitance and form-release agents from concrete.
4. Clean metal, glass, porcelain enamel, glazed surfaces of tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming (Elastomeric Sealants Only): Prime joint substrates where recommended in writing by joint sealant manufacturer, based on prior testing and experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

A. Silicone Glazing Sealants: Refer to Section 08 80 00.

B. Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

C. Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants applicable to materials, applications, and conditions indicated.

D. Sealant Backings: Install sealant backings to support sealants during application and at position necessary to produce cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings. Trim for tight fit around obstructions or elements penetrating the joint.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that become wet before sealant application and replace with dry sealant backings.
4. Install bond breaker tape behind sealants where backings are not used between sealants and back of joints.

E. Weeps and Vents: Install weeps and vents into joints at the same time sealants are being installed. Locate weeps and vents spaced recommended by sealant manufacturer and the window and curtain wall fabricator and erector. Do not install weeps and vents at outside building corners. Do not install vents at horizontal joints immediately below shelf angles, sills, and through wall flashings.

F. Sealants: Install sealants by proven techniques resulting in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at same time sealant backings are installed.
1. Apply sealants in depth in accordance with manufacturer's recommendations and recommended general proportions and limitations.
2. Apply elastomeric sealants, in joints not subject to traffic or abrasion, to a depth equal to 50% of the joint width, but not less than 1/4 inch (6 mm) and not more than 1/2 inch (13 mm).
3. Apply nonelastomeric sealants to a depth approximately equal to the joint width.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform, beads to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces. Tool exposed surfaces of sealants to the profile shown, or if none is shown, tool slightly concave.
   1. Use masking tape to protect adjacent surfaces of recessed tooled joints.
   2. Provide a slight wash on horizontal joints where horizontal and vertical surfaces meet.
   3. Against rough surfaces or in joints of uneven widths avoid the appearance of excess sealant or compound by locating the compound or sealant well back into joint wherever possible.

H. Installation of Preformed Silicone Sealant System:
   1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
   2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch (10 mm). Hold edge of sealant bead 1/4 inch (6 mm) inside masking tape.
   3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
   4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.

I. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.

J. Acoustical Sealant Installation: At sound rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer written recommendations.

3.4 FIELD QUALITY CONTROL

A. Field Adhesion Testing: Field test exterior wall joint sealant adhesion to joint substrates:
   1. Extent of Testing: Test completed and cured sealant joints:
      a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
      b. Perform 1 test for each 1000 feet (300 m) of joint length thereafter or 1 test per each floor per elevation.

   2. Test Method: Test joint sealants according to Method A, Field Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
   3. Inspect tested joints and report on the following:
      a. Whether sealants filled joint cavities and are free of voids.
      b. Whether sealant dimensions and configurations comply with specified requirements.

c. Whether sealants in joints connected to pulled out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer field adhesion hand pull test criteria.

4. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure original sealant surfaces are clean and new sealant contacts original sealant.

B. Evaluation of Field Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 SITE ENVIRONMENTAL PROCEDURES

A. Indoor Air Quality: Provide temporary ventilation during work. Coordinate interior application of sealants with interior finishes schedule.

3.6 CLEANING AND PROTECTION

A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

B. Protect joint sealants during and after curing from contact with contaminating substances and from damage so sealants are without deterioration or damage at time of Substantial Completion. If, despite protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 07 92 00

SECTION 07 95 00 - EXPANSION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Expansion joint cover assemblies.
   2. Accessories necessary for a complete installation.

1.3 PERFORMANCE REQUIREMENTS

A. Expansion Joint Design Criteria:
   1. Type of Movement: Thermal and wind sway.
      a. Nominal Joint Width: Indicated on Drawings.
      b. Minimum Joint Width: Indicated on Drawings.
      c. Maximum Joint Width: Indicated on Drawings.

1.4 SUBMITTALS

A. Product Data: Technical data for each type of product including construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.

B. Shop Drawings: Submit for each expansion joint cover assembly.
   1. Include plans, elevations, sections, details, splices, block out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
   2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.

C. Expansion Joint Cover Assembly Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
   1. Manufacturer and model number for each expansion joint cover assembly.
   2. Expansion joint cover assembly location cross-referenced to Drawings.
   3. Nominal, minimum, and maximum joint width.
   4. Movement direction.
   5. Materials, colors, and finishes.
   6. Product options.
   7. Fire resistance ratings.

D. Product Test Reports: For each fire resistance rated expansion joint cover assembly, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Fire Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to UL 2079 or ASTM E 1966 by a qualified testing agency.

a. Hose Stream Test: Wall-to-wall and wall-to-ceiling assemblies shall be subjected to hose stream testing.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 for extrusions; ASTM B 209 (ASTM B 209M), Alloy 6061-T6 for sheet and plate. Apply protective coating on aluminum surfaces in contact with cementitious materials.

B. Elastomeric Seals: Preformed elastomeric membranes or extrusions to be installed in metal frames.

C. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to comply with performance criteria for required fire-resistance rating.

D. Moisture Barrier: Flexible elastomeric material. Continuous, waterproof membrane within joint and attached to substrate on sides of joint. Provide where indicated on Drawings.

E. Nonmetallic, Shrinkage Resistant Grout: ASTM C 1107/C 1107M, factory packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30 minute working time.

F. Fasteners: Recommended attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.2 FLOOR EXPANSION JOINT COVERS

A. Metal Plate Floor Joint Cover: Metal cover plate fixed on one side of joint gap and free to slide on other.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
      b. Construction Specialties, Inc.
      c. InPro Corporation (IPC).
      d. MM Systems Corporation.
      e. Nystrom, Inc.
      f. BASF.
      g. Balco.

   2. Application: Floor to wall.
   3. Installation: Surface mounted.
   4. Load Capacity:
      a. Uniform Load: 50 lb/sq. ft. (244 kg/sq. m).
      b. Concentrated Load: 300 lb (136 kg).
      c. Maximum Deflection: 0.0625 inch (1.6 mm).

   5. Fire Resistance Rating: Not less than indicated on Drawings and adjacent construction.
   6. Cover Plate Design: Plain.
   7. Exposed Metal: Aluminum, clear anodic, Class I.

B. Elastomeric Seal Floor Joint Cover: Assembly consisting of elastomeric seal anchored to frames fixed to sides of joint gap.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Architectural Art Manufacturing Inc.
      b. Construction Specialties, Inc.
      c. EMSEAL Joint Systems, Ltd.
      d. InPro Corporation (IPC).
      e. MM Systems Corporation.
      f. Nystrom, Inc.
      g. BASF.
      h. Balco, a CSW Industrials Company.

   2. Application: Floor to floor.
   3. Installation: Indicated on Drawings.
   4. Load Capacity:
      a. Uniform Load: 50 lb/sq. ft. (244 kg/sq. m).
      b. Concentrated Load: 300 lb (136 kg).
      c. Maximum Deflection: 0.0625 inch (1.6 mm).

   5. Fire Resistance Rating: Not less than that indicated on Drawings and adjacent construction.
   6. Exposed Metal: Aluminum, clear anodic, Class I.
   7. Seal: Preformed elastomeric membrane or extrusion.

2.3 WALL EXPANSION JOINT COVERS

A. Metal Plate Wall Joint Cover: Metal cover plate fixed on one side of joint gap and free to slide on other.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
      b. Construction Specialties, Inc.
      c. InPro Corporation (IPC).
      d. MM Systems Corporation.
      e. Nystrom, Inc.
      f. BASF.
      g. Balco, a CSW Industrials Company.

   2. Application: Wall to wall.
   3. Fire Resistance Rating: Not less than indicated on Drawings and adjacent construction.
   4. Exposed Metal: Aluminum, clear anodic, Class I.

2.4 CEILING EXPANSION JOINT COVERS

A. Metal Plate Ceiling Joint Cover: Metal cover plate fixed on one side of joint gap and free to slide on other.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Architectural Art Manufacturing Inc.
      b. Construction Specialties, Inc.
      c. InPro Corporation (IPC).
      d. MM Systems Corporation.
      e. Nystrom, Inc.
      f. Balco, a CSW Industrials Company.

2. Application: Wall to ceiling.
3. Fire Resistance Rating: Not less than indicated on Drawings and adjacent construction.
4. Exposed Metal: Aluminum, Clear anodic, Class I.

2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the work.

B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.

C. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.

B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

C. Furnish units in longest practicable lengths to minimize field splicing.

D. Include factory fabricated closure materials and transition pieces, T joints, corners, curbs, cross connections, and other accessories as required to provide continuous expansion joint cover assemblies.

3.3 INSTALLATION

A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.

B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.
1. Repair or grout block out as required for continuous frame support using nonmetallic, shrinkage resistant grout.
2. Install frames in continuous contact with adjacent surfaces.
   a. Shimming is not permitted.
3. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
4. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
5. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.

C. Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
   1. Provide in continuous lengths for straight sections.
   2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
   3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure sensitive tape as recommended by manufacturer.

D. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.

E. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.

F. Fire Resistance Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work so complete assemblies comply with performance requirements.
   1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

G. Moisture Barrier Drainage: If indicated, provide drainage fittings and connect to drains.

3.4 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion joint cover assemblies. Reinstall cover plates or seals prior to Substantial Completion.

END OF SECTION 07 95 00

SECTION 08 14 23 – PLASTIC-LAMINATE-FACED WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 RELATED SECTIONS

A. Section 06 20 00 – Finish Carpentry & Millwork.

B. Section 08 11 00 – Metal Doors and Frames.

C. Section 08 71 00 – Door Hardware.

D. Section 08 80 00 – Glazing.

E. Section 09 90 00 – Paintings and Coatings.

1.3 REFERENCES

A. Architectural Woodwork Institute (AWI) – Veneer Standards.

B. National Fire Protection Association (NFPA)
1. 80, Fire Doors and Fire Windows
2. 252, Fire Tests of Door Assemblies

C. Underwriters Laboratories (UL)
1. Building Materials Directory
2. Listing and Labeling
3. 10 (c), Fire Tests of Door Assemblies - Positive Pressure

D. Wood Door and Window Manufacturers Association (WDMA) I.S. 1A – Flush Wood Door Performance Standards

E. Intertek Testing, Services (Warnock Hersey, Inc. (WHI))
1. Certification Listings for Fire Doors

1.4 SUBMITTALS

A. Product Data:
1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
2. Manufacturer's installation instructions.

B. Shop Drawings:
1. Show or schedule location, size, thickness, elevation, details of construction, location and extent of hardware blocking, fire rating, and other pertinent data for each door required.
2. Include schedule of hardware preparation required for each door.
3. Indicate requirements for veneer matching.

C. Samples: Plastic laminate in colors and patterns for Architect's selection.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with AWI Quality Standards, Custom Grade A.

B. Comply with WDMA I.S. 1A, 2004 Edition “Industry Standard for Architectural Wood Flush Doors” and exceed Extra heavy Duty performance standards.

C. Fire Rated Door Construction:
   1. Conform to ASTM E2074, NFPA 252, or UL 10 (c) as applicable and as required by code authorities having jurisdiction.
   2. Fire doors shall bear labels, permanently attached to the hinge stile or to top rail that:
      a. Allows label to be visible when door is open.
      b. Are approved by and shows testing laboratory approval for classification specified, scheduled or required. The testing laboratory shall be UL or WHI.

D. Fire Rated Door Installation:
   1. Conform to NFPA 80 and as required by code authorities having jurisdiction.

1.6 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 00 – Project Management and Coordination.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver to site, store, protect, and handle doors in accordance with AWI Quality Standards and manufacturer’s instructions. Accept doors on site in manufacturer’s standard packaging. HVAC systems shall be operating and balanced prior to arrival of doors. Acceptable humidity shall be no less than 25 percent nor greater than 55 percent.

B. Storage:
   1. Store doors in a clean and dry location protected from weather and abuse.
   2. Stabilize moisture content prior to installation.

C. Mark each door on the top or in the top hinge with opening numbers corresponding to approved shop drawings.

1.8 WARRANTY

A. Provide for lifetime replacing, including cost of rehanging and refinishing, at no cost to Owner, wood doors exhibiting defects in materials or workmanship including, but not limited to the following:
   1. Warp in excess of 1/4 inch as defined by AWI.
   2. Warp or twist to a degree that door will not operate properly.
   3. Delamination of face.
   4. Telegraphing or show through of stiles, rails, or core greater than 0.01 inch in any 3 inch area.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Manufacturers listed or named in the specifications who produce equivalent products to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with requirements of Division 1 regarding substitutions to be considered.
   1. Doors:
      a. Door Pro Systems; (713-462-0860).
      b. VT Industries; (712-368-4381).

c. Eggers Industries; (920-722-6444).
d. Marshfield Doors Systems, Inc.; (715-384-2141).
e. Oshkosh Architectural Door Company; (920-233-6161).

2. Plastic Laminate:
a. Wilsonart International; (800-433-3222).
b. Formica Corp.; (1-800-367-6422).
c. Panolam Industries International; (1-877-726-6526)
d. Pionite Decorative Surfaces.

2.2 MATERIALS

A. Flush Interior Non-Rated Wood Doors – Plastic Laminate:
1. General: 3-ply AWI PC-HPDL-3 High Pressure Decorative Laminate (HPDL), Bonded Particle Core, stile and rails abrasively planed as an assembly prior to laminating, factory machine and fit.
2. Thickness: 1-3/4 inch.
3. Core: 32 lbs per cubic foot particleboard, 1LD2 in accordance with ANSI A208.1
a. Furnish Structural Lumber Core:
1) At doors with more than 40 percent of door core removed due to light or vent cutouts.
2) At doors with exit devices.

4. Stile: LSL, 1-3/8 inch, bonded to core
5. Rail: LSL bonded to core, 1-1/8 inch minimum, 5 inch head rail for closer reinforcement.

B. Accessories:
1. Glazing: Factory glaze with glass as indicated. Verify compatibility of glazing system with positive pressure requirements where applicable.
2. Glass Stops: Glass stops, if any, shall be metal type painted to match door frame under Section 09 90 00. Stops prepared for countersink style tamper proof screws. Size for 6 inch by 36 inch vision glass, unless noted otherwise. Color will be approved by Architect.
3. Adhesive: Type 1, hot pressed
4. Plastic Laminate: 0.050 inch thick, as selected by Architect.
Seal top, bottom and cut surface of openings at factory with two (2) coats of varnish.
5. Vertical door edges shall be factory painted to match door face. Factory shall supply matching paint and edges shall be touched-up in field.

C. Fabrication:
1. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame shop drawings, DHI A115-W series standards, and hardware templates.
2. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
3. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
4. Doors with mortised hinges to be furnished pre-drill pilot holes for hinge screws.
5. Electrical Wiring: Provide flush wood doors receiving electrified hardware with concealed wiring harness and standardized Molex plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through wire transfer hardware or wiring harness specified in hardware sets in Division 8 “Door Hardware”.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Doors and hardware installed under Section 06 20 00, Finish Carpentry and Millwork. Follow manufacturer's printed instructions. Coordinate work with door opening construction, and door and frame hardware installation.

B. Clearances:
   1. Head and Jambs, meeting edges: 1/8 inch maximum.
   2. Sill: 1/2 inch typically, except provide 1/4 inch clearance from top surface of carpeting.

C. Verify that frames comply with indicated requirements for type, size, location and swing characteristics and that the frames are installed plumb, level and parallel. Reject doors with defects that are not repairable.

D. Coordinate hardware installation for proper door operation. Adjust locks and latches to engage snugly without forcing. Align hardware to function without squeaking, binding, or racking. Mortise as required for automatic door bottoms.

E. Protect doors from damage and replace doors that are damaged. Verify that tops and bottoms of doors have been sealed prior to installation, as required for warranty.

3.2 CLEANING AND REPAIRING

A. Clean doors in accordance with manufacturer's instructions.

B. Repair or replace damaged doors at no expense to Owner.

C. Do not remove or paint over labels on labeled doors.

END OF SECTION 08 14 23

SECTION 08 16 00 – FIBERGLASS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Providing Fiberglass Reinforced Plastic (FRP) Doors and Fiberglass Resin Transfer Molded Door Frames, with all fasteners and accessories required for a complete installation.

1.3 RELATED SECTIONS

A. Section 04 20 00 - Unit Masonry: Masonry work in which doorframes are installed.

B. Section 08 80 00 - Glazing: Vision glazing in doors, if any.

1.4 QUALITY ASSURANCE

A. Referenced Standards:
   1. Door Assembly:
      a. ASTM C518, Standard test method for steady state thermal transmission properties by means of the heat flow meter apparatus.

   2. Laminate Properties:
      a. ASTM D256, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics = 15.75 psi
      b. ASTM D635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
      c. ASTM D638 Standard Test Method for Tensile Properties of Plastics = 15,000 psi.
      d. ASTM D790, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials Strength = 39,000 psi
      e. ASTM D792 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
      f. ASTM D1761, Standard Test Method for Mechanical Fasteners in Wood
      g. ASTM D2583, Standard Test Method for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor = 57
      h. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
      i. ASTM G155, Standard Practice for Operating Xenon Arc light Apparatus for Exposure of Non-Metallic Materials

   3. Core Properties:
      a. ASTM C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
      b. ASTM D1622, Standard Test Method for Apparent Density of Rigid Cellular Plastics
      c. ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials
      d. WDMA TM-10 and TM-5 Firestop ASTM E2074 U.L. 10(b)

B. Qualifications:
   1. Manufacturer Qualifications: A company specialized in the manufacture of fiberglass reinforced plastic (FRP) doors and frames as specified herein with a minimum of 25 years documented experience and with a record of successful in-service performance for the applications as required for this project.
   2. Installer Qualifications: An experienced installer who has completed fiberglass door and frame installations similar in material, design, and extent to those indicated and whose work has resulted in construction with a record of successful in-service performance.
   3. Source Limitations: Obtain fiberglass reinforced plastic doors and frames through one source fabricated from a single manufacturer, including fire rated fiberglass frames.
   4. Source Limitations: Hardware and accessories for all FRP doors as specified in Section 08 71 00 should be provided and installed by the fiberglass door and frame manufacturer.
   5. Source Limitations: Glass for windows in doors shall be furnished and installed by door and frame manufacturer in accordance with Section 08 80 00.

1.5 SUBMITTALS

A. Product Technical Data Including:
   1. Acknowledgment that products submitted meet requirements of standards referenced.
   2. Manufacturer shall provide certificate of compliance with current local and federal regulations as it applies to the manufacturing process.
   3. Manufacturer's installation instructions.
   4. Schedule of doors and frames indicating the specific reference numbers as used on drawings, door type.
   5. Details of core and edge construction. Include factory-construction specifications.
   6. Certification of manufacturer's qualifications.

B. Submittal Drawings For Customer Approval Shall Be Submitted Prior To Manufacture And Will Include The Following Information And Formatting:
   1. Summary door schedule indicating the specific reference numbers as used on Architect’s drawings, with columns noting door type, frame type, size, handing, accessories and hardware.
   2. A drawing depicting front and rear door elevations showing hardware with bill of material for each door.
   3. Drawing showing dimensional location of each hardware item and size of each door.
   4. Individual part drawing and specifications for each hardware item and FRP part or product.
   5. Construction and mounting detail for each frame type.

C. Samples:
   1. Provide one (1) 21 inch x 18 inch completely assembled (hinged) door and frame corner section, with faces and edges representing typical color and finish. One (1) edge shall be exposed for view of interior door and frame composition. Sample shall include six (6) inch light opening as well as standard cutouts for hinges and strike plates.

D. Operation and Maintenance Manuals:
   1. Include recommended methods and frequency for maintaining optimum condition of fiberglass doors and frames under anticipated traffic and use conditions.
   2. Include one (1) set of final as built drawings with the same requirements as mentioned in Paragraph B above.
   3. Include certificate of warranty for door and frame listing specific door registration numbers.
   4. Include hardware data sheets and hardware manufacturer's warranties.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Each door and frame should be delivered individually crated for protection from damage in cardboard containers, clearly marked with project information, door location, specific reference number as shown on drawings, and shipping information. Each crate should contain all fasteners necessary for installation as well as complete installation instructions.

B. Doors should be stored in the original container out of inclement weather for protection against the elements.

C. Handle doors pursuant to the manufacturer's recommendations as posted on outside of crate.

1.7 WARRANTY

A. Warranty all fiberglass doors and frames for a period of 25 years against failure due to corrosion. Additionally, warranty all fiberglass doors and frames on materials and workmanship for a period of ten (10) years, including warp, separation or delamination, and expansion of the core.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Specifications are based on Chem-Pruf Door Co., Ltd., Brownsville, Texas; (800) 444-6924. Manufacturers listed below who produce products equivalent to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with requirements of Division 1 regarding substitutions to be considered.
   1. Cline FRP Doors, Bradenton, Florida; (800) 648-6736
   2. Special-Lite, Inc., Decatur, Michigan; (800) 821-6531
   3. Tiger Door Company, LLC, An Overly Door Company, Omaha, Nebraska; (888) 891-4416

2.2 FRP DOORS

A. Doors shall be made of fiberglass reinforced plastic (FRP) using chemically proven resins resistant to contaminants typically found in the environment for which these specifications are written. Doors shall be 1-3/4 inch thick and of flush construction, having no seams or cracks. All doors up to 4 feet-0 inches x 8 feet-0 inches shall have equal diagonal measurements with a maximum tolerance of +/- 1/32 inch.

B. Door Plates shall be +/- 0.125 inch thick, molded in one continuous piece, starting with a 25 mil polyurethane coating of the color specified, integrally molded with at least two (2) layers of 1.5 ounce per square foot fiberglass mat and one (1) layer of 13 ounce per square yard unidirectional roving. This will yield a plate weight of 0.97 lbs per square foot at a ratio of 30/70 glass to resin.

C. Stiles and Rails shall be constructed starting from the outside toward the inside, of a 25 mil polyurethane coating of the color specified followed by a matrix of at least three (3) layers of 1.5 ounce per square foot of fiberglass mat. The stile and rail shall be molded in one continuous piece to a U-shaped configuration and to the exact dimensions of the door. In this manner there will be no miter joints or disparate materials used to form the one-piece stile and rail.

D. Core material shall be 2 psf expanded polyurethane foam, which completely fills all voids between the doorplates. Class A in accordance with ASTM E-84 with a maximum flame spread of 75 and maximum smoke development of 450.

E. Internal Reinforcement shall be NWPF of sufficient amount to adequately support required hardware and function of the same.

F. Finish of door and frame shall be identical in color and texture. At time of manufacture, 25 mil of resin-rich polyurethane coating must be integrally molded into both the door and frame. Secondary painting to achieve color is not acceptable.

G. Window openings shall be provided for at time of manufacture and shall be completely sealed so that the interior of the door is not exposed to the environment. Fiberglass retainers who hold the glazing in place shall be resin transfer molded with a profile that drains away from glazing. The retainers must match the color, texture and finish of the doorplates. Glass shall be furnished and installed by door and frame manufacturer.

H. Louver openings shall be sealed in the same manner as the window openings. Louvers are to be solid fiberglass inverted "V" vanes and shall match the color, texture and finish of the doorplates.

I. Transoms shall be identical to the doors in construction, materials, thickness and reinforcement.

2.3 FRP FRAMES

A. Frames shall be fiberglass and manufactured using the resin transfer method in closed rigid molds to assure uniformity in color and size. Beginning with a minimum 25 mil polyurethane coating and a minimum of two (2) layers continuous strand fiberglass mat saturated with resin, the frame will be of one-piece construction with molded stop. All frame profiles up to 3/4 inch will be solid fiberglass. All frame profiles greater than 3/4 inch shall have a core material of 2 psf polyurethane foam. Metal frames or pultruded fiberglass frames will not be accepted.

B. Finish of frame shall be identical in color and texture to the door. 25 mil resin rich polyurethane coating will be integrally molded into the frame at time of manufacture. Secondary painting to achieve color is not acceptable.

C. Jamb/Header connection shall be coped by CNC for tight fit.

D. Internal Reinforcement shall be continuous within the structure to allow for mounting of specified hardware. Material shall be completely non-organic with a minimum hinge screw holding value of 656 lbs. Frame screw holding value to accommodate screw shall be minimum of 1,000 lbs per screw. Documented strength of frame screw holding value after third insert must be submitted. Dissimilar materials, such as steel, will be deemed unacceptable as reinforcement for hardware attachment.

E. Mortises for hardware shall be accurately machined by CNC to hold dimensions to +/- 0.010 inch in all three (3) axis.

F. Hinge pockets shall be accurately machined by CNC to facilitate heavy-duty hinges at all hinge locations, using spacers when standard weight hinges are used.

2.4 HARDWARE

A. Due to the special nature of the material in this Section, all related hardware as specified must be furnished and installed by the door and frame manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION CONDITIONS

A. Verification of Conditions:

1. Openings are correctly prepared to receive doors and frames.
2. Openings are correct size and depth in accordance with shop drawings or submittals.

B. Installer's Examination:
1. Have the installer examine conditions under which construction activities of this section are to be performed and submit a written report if conditions are unacceptable.
2. Transmit two (2) copies of the installer's report to the architect within 24 hours of receipt.
3. Beginning construction activities of this Section before unacceptable conditions have been corrected is prohibited.

3.2 INSTALLATION

A. Install door-opening assemblies in accordance with shop drawings and manufacturer's printed installation instructions, using installation methods and materials specified in installation instructions.

B. Field alteration of doors or frames to accommodate field conditions is strictly prohibited.

C. Site tolerances: Maintain plumb and level tolerance specified in manufacturer's printed installation instructions.

D. Fire labeled doors and frames must be installed in strict accordance with manufacturer's instructions and the latest revision of NFPA 80.

3.3 ADJUSTING

A. Adjust doors in accordance with door manufacturer's maintenance instructions to swing open and shut without binding and to remain in place at any angle without being moved by gravitational influence.

B. Adjust door hardware to operate correctly in accordance with hardware manufacturer's maintenance instructions.

3.4 CLEANING

A. Clean surfaces of door opening assemblies and exposed door hardware in accordance with respective manufacturer's maintenance instructions.

3.5 PROTECTION OF INSTALLED PRODUCTS

A. Protect door opening assemblies and door hardware from damage by subsequent construction activities until final inspection and acceptance.

END OF SECTION 08 16 00

SECTION 08 41 13 – ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Exterior and interior storefront framing.
   2. Exterior and interior manual swing entrance doors.
   3. Aluminum Sun Shade.
   4. Accessories necessary for a complete installation.

1.3 PERFORMANCE REQUIREMENTS

A. Performance: Aluminum framed systems shall withstand the effects of specified performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
   1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
   2. Dimensional tolerances of building frame and other adjacent construction.
   3. Failure includes the following:
      a. Deflection exceeding specified limits.
      b. Thermal stresses transferring to building structure.
      c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
      d. Noise or vibration created by wind and by thermal and structural movements.
      e. Loosening or weakening of fasteners, attachments, and other components.
      f. Sealant failure.
      g. Failure of operating units.

B. Structural Loads:
   1. Wind Loads: Indicated on Drawings.

C. Deflection of Framing Members:
   1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch19 mm, whichever is less.
   2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch3.2 mm, whichever is smaller.

D. Structural Test Performance: Provide aluminum framed systems tested according to ASTM E 330 as follows:
   1. When tested at positive and negative wind load design pressures, systems do not evidence deflection exceeding specified limits.
   2. When tested at 150 percent of positive and negative wind load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
   3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft.0.03 L/s per sq. m of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa.

F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa.

G. Windborne Debris Impact Resistance: Pass missile impact and cyclic pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 for Wind Zone 4.
   1. Large Missile Test: For glazed openings located within 30 feet (9.1 m) of grade.

H. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 degrees F (67 degrees C, ambient; 180 degrees F100 degrees C, material surfaces.
   2. Interior Ambient-Air Temperature: 75 degrees F (24 degrees C.

I. Condensation Resistance: Provide aluminum framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.

J. Thermal Conductance: Provide aluminum framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.57 Btu/sq. ft. x h x degrees F3.23 W/sq. m x K when tested according to AAMA 1503.

1.4 SUBMITTALS

A. Product Data: Technical data for each type of product indicated including construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum framed systems.

B. Shop Drawings: Submit aluminum storefront framing and entrances shop drawings including plans, elevations, sections, full size details, and attachments to other Work.
   1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
   2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

C. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related Work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

D. Engineer’s calculations of performance requirements.

E. Maintenance Data: For aluminum framed systems to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Accessibility Requirements: Comply with applicable requirements.

a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
c. Texas Accessibility Standards (TAS) 2012.

B. Installer Qualifications: Installer having minimum 10 years documented experience who is an authorized representative of the manufacturer and is trained and approved for installation of units required.

C. Engineering Responsibility: Prepare data for aluminum framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated.

D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in service performance.
1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

E. Source Limitations: Obtain aluminum framed entrances from single source from single manufacturer.

F. Preinstallation Conference: Conduct conference at site.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 WARRANTY

A. Warranty: Written warranty signed by Manufacturer, Contractor, and Installer in which manufacturer agrees to repair or replace components of aluminum framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration caused by thermal movements.
c. Water leakage through fixed glazing and framing areas.
d. Failure of operating components.

2. Warranty Period: Two years from date of Substantial Completion.

B. Finish Warranty: Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
1. Warranty Period: 10 years from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

A. Entrance Door Hardware:
   1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
   2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Basis of Design: Kawneer Trifab 451/451T (Product Evaluation CWSF-34), impact resistant system, maximum design pressure +/- 45 psf. Subject to compliance with requirements, provide comparable storefront system by one of the following:
   1. EFCO Corporation.
   2. Old Castle Building Envelope
   3. Tubelite, Inc.
   4. US Aluminum Corporation.
   5. Vistawall.
   6. YKK America AP, Inc.

B. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   1. Sheet and Plate: ASTM B 209ASTM B 209M.
   2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221ASTM B 221M.
   3. Extruded Structural Pipe and Tubes: ASTM B 429.
   4. Structural Profiles: ASTM B 308/B 308M.

C. Framing Members: Extruded aluminum framing members of thickness required and reinforced necessary to support imposed loads.
   1. Construction: Nonthermal/Thermal.
   2. Glazing System: Retained mechanically with gaskets on four sides.
   3. Glazing Plane: Center.

D. Accessories:
   1. Brackets and Reinforcements: High strength aluminum with nonstaining, nonferrous shims for aligning system components.
   2. Fasteners and Accessories: Corrosion resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
      a. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
      b. Reinforce members as required to receive fastener threads.
   3. Concrete and Masonry Inserts: Hot dip galvanized cast iron, malleable iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
   4. Concealed Flashing: Corrosion resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
   5. Framing System Gaskets and Sealants: Recommended by manufacturer for joint type.

E. Glazing: Refer to Section 08 80 00 for impact resistant laminated insulating glass with low-e coating on Number 2 surface.
   1. Glazing Gaskets: Compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
   2. Spacers and Setting Blocks: Elastomeric type.

F. Entrance Doors: Glazed entrance doors for manual swing operation.
   1. Door Construction: 1-3/4 inch (44.5 mm) overall thickness, with minimum 0.125 inch (3.2 mm) thick, extruded aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
   2. Door Design: Nominal width of 6 inch (152.4 mm) vertical stiles and 6-1/2 inch (165.1 mm) bottom rail.
   3. Glazing Stops and Gaskets: Square, snap on, extruded aluminum stops and preformed gaskets.

G. Entrance Door Hardware: Refer to Section 08 71 00 for aluminum entrance hardware sets.
   1. Basis of Design: Series 500 Wide Stile, swing door standard as manufactured by Kawneer Co., Inc. or equivalent product from list of approved manufacturers.
   2. Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section.
      a. Opening-Force Requirements:
         1) Egress Doors: Maximum than 15 lbf 67 N to release the latch and not more than 30 lbf 133 N to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
         2) Accessible Interior Doors: Maximum 5 lbf to fully open door.
      b. Weather Stripping: Standard replaceable components to match existing.
      c. Weather Sweeps: Standard exterior door bottom sweep with exposed fasteners on mounting strip to match existing.

H. Aluminum Sun Shade:
   1. Aluminum: Extruded aluminum shall be 6063-T5
   2. Description: aluminum sunshade consisting of outriggers, louvers, and fascia that is anchored directly to the vertical curtain wall mullions.
   3. Outrigger Style: As selected by Architect.
   4. Color/Finish: As selected by Architect.
   5. Product/Manufacturer: Versoleil by Kawneer; or comparable product approved by Architect.

I. Accessories:
   1. Joint Sealants: For installation at perimeter of aluminum framed systems, refer to Section 07 92 00.
   2. Bituminous Paint: Cold applied, asphalt mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30 mil 0.762 mm thickness per coat.

2.3 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Framing Members: Fabricate components that, when assembled, have specified characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.

2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
8. Provide sill receptors with end dams at all sill conditions.

C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

D. Storefront Framing: Fabricate components for assembly using screw spline system.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
1. At exterior doors, provide weather stripping at fixed stops.
2. At interior doors, provide weather stripping at stops to prevent metal to metal contact.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
1. At pairs of exterior doors, provide compression type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.4 ALUMINUM FINISHES

H. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and conditions affecting performance of the Work. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. Comply with aluminum framed storefront manufacturer recommended installation instructions. Coordinate installation with curtain wall work.
1. Do not install damaged components.
2. Fit joints to produce hairline joints free of burrs and distortion.
3. Rigidly secure nonmovement joints.
4. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
5. Seal joints watertight unless otherwise indicated.

B. Metal Protection:
   1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
   2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing specified in Section 08 80 00.

G. Entrance Doors and Hardware: Install doors to produce smooth operation and tight fit at contact points.
   1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
   2. Field Installed Entrance Door Hardware: Install surface mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Install perimeter joint sealants as specified in Section 07 92 00 to produce weathertight installation.

3.3 ERECTION TOLERANCES

A. Install aluminum framed systems to comply with the following maximum erection tolerances:
   1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
   2. Alignment:
      a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch1.5 mm.
      b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch0.8 mm.

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch3 mm.

3.4 ADJUSTING

A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
   1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches 75 mm from the latch, measured to the leading door edge.

END OF SECTION 08 41 13

SECTION 08 51 00 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Aluminum windows for exterior locations.
   2. Accessories necessary for a complete installation.

1.3 WINDOW PERFORMANCE REQUIREMENTS

A. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440:

B. Solar Heat Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.30

C. Windborne Debris Impact Resistance: Capable of resisting impact from windborne debris based on testing glazed windows identical to those specified, according to ASTM E 1886 and testing information in ASTM E 1996 and requirements of authorities having jurisdiction.

1.4 SUBMITTALS

A. Product Data: Technical data for each type of product, including construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.

B. Shop Drawings: Submit plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples: For each exposed product and for each color specified, 2 by 4 inches (50 by 100 mm) in size.

D. Samples: For aluminum windows and components required, showing full range of color variations for finishes, and prepared on Samples of size indicated below:
   1. Exposed Finishes: 2 by 4 inches (50 by 100 mm).
   2. Exposed Hardware: Full size units.

E. Product Schedule: Use same designations indicated on Drawings.

F. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.

G. Field quality control reports.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Energy Code: Provide window units compliant with the IECC with Texas amendments,

2. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
    a. Window Certification: AAMA certified with label attached to each window.

3. Texas Department of Insurance, Windstorm Regulations; provide products listed in the Product Evaluation Index and having a current report number.
4. Accessibility Requirements: Comply with applicable requirements.
    a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
    b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
    c. Texas Accessibility Standards (TAS).

B. Manufacturer Qualifications: Manufacturer having minimum 5 years documented experience who is capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting the performance by test reports and calculations.

C. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

D. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

E. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
1. Build mockup of typical wall area as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at site.
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

G. Preinstallation Conference: Conduct conference at site.

1.6 WARRANTY

A. Manufacturer's Warranty: Written warranty signed by Manufacturer in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    a. Failure to meet performance requirements.
    b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
    c. Faulty operation of movable sash and hardware.

d. Deterioration of materials and finishes beyond normal weathering.
e. Failure of insulating glass.

2. Warranty Period:
a. Window: 10 years from date of Substantial Completion.
b. Glazing Units: 10 years from date of Substantial Completion.
c. Aluminum Finish: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers: Subject to compliance with requirements, provide impact resistant window products by one of the following:
1. Arcadia, Inc.
2. EFCO Corporation.
3. Kawneer North America; an Alcoa company.
4. Peerless Products, Inc.
5. Wausau Window and Wall Systems; Apogee Wausau Group.
6. Winco Manufacturing Co.

B. Operating Types: Provide the following operating types in locations indicated on Drawings:
1. Fixed window.

C. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal to metal contact.

D. Glass: Clear annealed glass, ASTM C 1036, Type 1, Class 1, q3.
1. Kind: Fully tempered.

E. Windborne Debris Impact Resistant Insulating Glass: ASTM E 2190, factory assembled sealed glass unit units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
1. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
2. Spacer: Aluminum with black, color anodic finish.
3. Desiccant: Molecular sieve or silica gel, or a blend of both.
4. Overall Unit Thickness: 1 inch (25 mm).
5. Minimum Thickness of Each Glass Lite: 6 mm.
6. Outdoor Lite: Low E tinted float glass, impact resistant laminated glass.
7. Interspace Content: Air.
8. Indoor Lite: Fully tempered float glass.

F. Hardware: Provide hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.
1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.

G. Projected Window Hardware:

1. Gear Type Rotary Operators: Complying with AAMA 901 when tested according to ASTM E 405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.
   a. Type and Style: Selected by Architect.

2. Hinges: Nonfriction type, not less than two per sash.
3. Lock: Lift type throw, cam action lock with keeper.
4. Pole Operators: Tubular shaped anodized aluminum; with rubber capped lower end and standard push pull hook at top to match hardware design; of sufficient length to operate window without reaching more than 60 inches (1500 mm) above floor; one pole operator and pole hanger per room that has operable windows more than 72 inches (1800 mm) above floor.

H. Weather Stripping: Provide full perimeter weather stripping for each operable sash unless otherwise indicated.

I. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
   1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.2 ACCESSORIES

A. Integral Ventilating System/Device: Where indicated, provide weather-stripped, adjustable, horizontal fresh air vent, with a free airflow slot, full width of window sash by approximately 1 inch (25 mm) when open, complying with AAMA/WDMA/CSA 101/I.S.2/A440. Equip vent bar with an integral insect screen, removable for cleaning.

B. Dividers (False Muntins): Provide extruded aluminum divider grilles in designs indicated for each sash lite.
   1. Type: Permanently located between insulating glass lites.
   2. Pattern: Indicated on Drawings.
   3. Profile: Selected by Architect.

C. Subsills: Thermally broken, extruded aluminum subsills in configurations indicated on Drawings.

D. Column Covers: Extruded aluminum profiles in sizes and configurations indicated on Drawings.

E. Interior Trim: Extruded aluminum profiles in sizes and configurations indicated on Drawings.

F. Panning Trim: Extruded aluminum profiles in sizes and configurations indicated on Drawings.

G. Receptor System: Two piece, snap together, thermally broken, extruded aluminum receptor system that anchors windows in place.

2.3 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Glaze aluminum windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

E. Provide water shed members above side-hinged sashes and similar lines of natural water penetration.

F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.

G. Window Assemblies: Provide fixed units in configuration indicated. Provide window frames, sashes, hardware, and other trim and components necessary for a complete, secure, and weathertight installation, including the following:
1. Angled mullion posts with interior and exterior trim.
2. Angled interior and exterior extension and trim.
3. Exterior head and sill casings and trim.

H. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.4 FINISH REQUIREMENTS

A. Comply with NAAMM *Metal Finishes Manual* for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.

D. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
   1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:
   1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
   2. Air Infiltration Testing:
      a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
      b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.

   3. Water Resistance Testing:
      a. Test Pressure: Two/thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
      b. Allowable Water Infiltration: No water penetration.

   4. Testing Extent: Three mockup windows of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
   5. Test Reports: Prepared according to AAMA 502.

C. Windows will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
   1. Keep protective films and coverings in place until final cleaning.

C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 08 51 00

SECTION 08 71 00

FINISH HARDWARE

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Work under this section comprises of furnishing hardware specified herein and noted on drawings for a complete and operational system, including any electrified hardware components, systems, controls and hardware for aluminum entrance doors. Any door shown on the drawing and not specifically referenced in the hardware sets shall be provided with identical hardware as specified on other similar openings and shall be included in the General Contractor's base bid. All fire rated door shall be provided with fire rated hardware as required by local code Authority as part of the General Contractor's base bid. The hardware supplier shall verify all cylinder types specified for locking devices supplied as part of the door system with the door manufacturer and/or door supplies.

B. The General Contractor shall notify the Architect in writing of any discrepancies (five (5) days prior to bid date) that could and/or would result in hardware being supplied that is none functional, hardware specified and/or hardware that has not been specified that will result in any code violations and any door that is not covered in this specification. Failure of the General Contractor to address any such issue could be considered acceptance of the hardware specified and all discrepancies could be corrected at the General Contractor's expense.

C. Items include but are not limited to the following:

1. Hinges - Pivots
2. Flush Bolts
3. Exit Devices
4. Locksets and Cylinders
5. Push Plates - Pulls
6. Coordinators
7. Closers
8. Kick, Mop and Protection Plates
9. Stops, Wall Bumpers, Overhead Controls
10. Electrified Hold Open Devices
11. Thresholds, Seals and Door Bottoms
12. Silencers
13. Miscellaneous Trim and Accessories

1.02 RELATED DOCUMENTS, drawings and general provisions of contract, including General and Supplementary Conditions, and Division 1 Specification sections, apply to this section.

1.03 RELATED WORK specified elsewhere that should be examined for its effect upon this section:

A. Section 06 20 00 - Finish Carpentry
B. Section 08 11 13 – Steel Doors and Frames
C. Section 08 14 16 – Flush Wood Doors
D. Section 08 31 13 – Access Doors
E. Section 08 39 00 – Watertight Doors
E. Section 08 41 13 – Aluminum Entrances, Storefront and Window Framing

F. Sections 08 80 00 – Glass and Glazing
G. Sections 09 91 00 - Painting
H. Division 26 – Electrical
I. Division 28 – Access Control

1.04 REFERENCES SPECIFIED in this section subject to compliance as directed:

A. NFPA-80 - Standard for Fire Doors and Windows
B. NFPA-101 - Life Safety Code
C. ADA - The Americans with Disabilities Act - Title III - Public Accommodations
D. ANSI-A 117.1 - American National Standards Institute - Accessible and Usable Buildings and Facilities
E. ANSI-A 156.5 - American National Standards institute -Auxiliary Locks and Associated Products
F. UFAS - Uniform Federal Accessibility Standards
G. UL - Underwriter's Laboratories
H. WHI - Warnock Hersey International, Testing Services
I. State and Local Codes including Authority Having Jurisdiction
J. UL10C – Positive Pressure
K. IBC-2015 – International Building Code
L. NFPA-70 – International Electrical Code

1.05 SUBMITTALS

A. HARDWARE SCHEDULES submit copies of schedule in accordance with Division 1, General Requirements. Schedule to be in vertical format, listing each door opening, including: handing of opening, all hardware scheduled for opening or otherwise required to allow for proper function of door opening as intended, and finish of hardware. At doors with door closers or door controls include degree of door opening. Supply the schedules all Finish Hardware within two (2) weeks from date purchase order is received by the hardware supplier.

B. Submit manufacturer's cut/catalog sheets on all hardware items and any required special mounting instructions with the hardware schedule.

C. Certification of Compliance:

1. Submit any information necessary to indicate compliance to these specifications as required.
2. Submit a statement from the manufacturer that electronic hardware and systems being supplied comply with the operational descriptions exactly as specified.

D. Submit any samples necessary as required by the Architect.

E. Templates for finish hardware items to be sent to related door and frame suppliers within three (3) working days of receipt of approved hardware schedule.

F. Doors and Frames used in positive pressure opening assemblies shall meet UL10C in areas where this specification includes Seals for smoke door.

1.06 QUALITY ASSURANCE

A. Hardware supplier to be a qualified, Factory Authorized, direct distributor of the products to be furnished. In addition, the supplier to have in their regular employment an AHC or AHC /CDC and/or a person of equivalent experience

(minimum fifteen (15) years in the industry) who will be made available at reasonable times to consult with the Architect/Contractor and/or the City of Edinburg Representative regarding any matters affecting the finish hardware on this project.

B. All hardware used in labeled fire or smoke rated openings to be listed for those types of openings and bear the identifying label or mark indicating UL. (Underwriter's Laboratories) approved for fire. Exit devices in non-labeled openings to be listed for panic.

1.07 DELIVERY, HANDLING AND PACKAGING

A. Furnish all hardware with each unit clearly marked and numbered in accordance with the hardware schedule. Include door and item number for each.

B. Pack each item of hardware completes with all necessary parts and fasteners.

C. Properly wrap and cushion each item to prevent scratches and dents during delivery and storage.

1.08 SEQUENCING AND SCHEDULING

Any part of the finish hardware required by the frame or door manufacturers or other suppliers that is needed to produce doors or frames is to be sent to those suppliers in a timely manner, so as not to interrupt job progress.

1.09 WARRANTY

All finish hardware shall be supplied with a one- (1) year warranty against defects in materials and workmanship, commencing with substantial completion of the project except as follows:

1. All Closers are to have a twenty-five- (25) year written warranty.
2. All Grade 1 (ND) Locksets are to have a ten- (10) year written warranty.
3. All Grade 1 (L9000) Locksets are to have a five- (5) year written warranty.
4. All Exit Devices are to have a three (3) year written warranty.

PART 2 – PRODUCTS

2.01 FASTENERS

A. Furnish with finish hardware all necessary screws, bolts and other fasteners of suitable size and type to anchor the hardware in position for a long life under hard use.

B. Furnish fastenings where necessary with expansion shields, toggle bolts and other anchors designated by the Architect according to the material to which the hardware is to be applied and the recommendations of the hardware manufacturer. All closers and exit devices on labeled wood doors shall be through-bolted if required by the door manufacturer. All thresholds shall be fastened with wood screws and plastic anchors. Where specified in the hardware sets, security type fasteners of the type called for are to be supplied.

C. Design of all fastenings shall harmonize with the hardware as to material and finish.

D. All hardware shall be installed with the Manufacturers standard screws as provided. The use of any other type of fasteners shall not be permitted. The general contractor shall provide wood blocking in all stud walls specified and/or scheduled to receive wall stops, No Exception.

2.02 ENVIRONMENTAL CONCERN FOR PACKAGING

The hardware shall ship to the job site is to be packaged in biodegradable packs such as paper or cardboard boxes and wrapping.

2.03 HINGES

A. All hinges to be of one manufacturer as hereafter listed for continuity and consideration of warranty. Provide one of the following manufacturers Ives, Hager or Stanley.

B. Unless otherwise specified provide five-knuckle, heavy-duty, button tip, full mortise template type hinges with non-rising loose pins. Provide non-removable pins for out swinging doors at secured areas or as called for in this specification (Refer to 3.02 Hardware Sets).

C. Provide all out-swinging doors with non-removable pins or security studs as called for in 3.02 Hardware Sets. Furnish three (3) hinges up to 90 inches high and one (1) additional hinge for every 30 inches or fraction thereof.

D. Furnish three (3) hinges up to 90 inches high and one (1) additional hinge for every 30 inches or fraction thereof.

E. Provide size 4½” x 4½” for all 1¾” thick doors up to and including 36 inches wide. Doors over 1¾” through 2¼” thick, use 5” x 5” hinges. Doors over 36 inches use 5” x 4½” unless otherwise noted in 3.02 Hardware Sets.

F. Were required to clear the trim and/or to permit the doors to swing 180 degrees furnish hinges of sufficient throw.

G. Provide heavy weight hinges on all doors over 36 inches in width.

H. Labeled fire rated doors provide steel bearing-type hinges shall be provided. For all doors equipped with closers provide bearing-type hinges.

2.04 LOCK AND LOCK TRIM

A. All the locksets, latch sets, and trim to be of one manufacturer as hereafter listed for continuity of design and consideration of warranty. Locksets specified are Schlage “ND & L9000” series with the Sparta/17 levers and are to be provided as specified.

B. Provide metal wrought box strike boxes and curved lip strikes with proper lip length to protect trim of the frame, but not to project more than 1/8 inch beyond frame trim or the inactive leaf of a pair of doors.

C. Mechanical Locks shall meet ANSI Operational Grade 1, Series 1000 & 4000 as specified.

1. Hand of lock is to be field reversible or non-handed.
2. All lever trim is to be through-bolted through the door.

3. Provide pairs of doors specified with locks with a ¾" latch projection.

2.05 CYLINDERS AND KEYING

A. Provide all exterior and interior locks or Exit Devices requiring cylinders keyed to the New Large Format Interchangeable Core Master Key System as instructed by the City of Edinburg Representative. Cylinders shall comply with performance requirements of ANSI A156.5. All keys shall be of nickel silver material only. The hardware supplier shall meet with the General Contractor, the Architect and the City of Edinburg Representative at the project jobsite to determine all permanent keying requirements.

B. Cylinders shall be factory keyed and factory maintained as directed by the City of Edinburg Representative and the Architect. Provide three- (3) keys per cylinder and six- (6) master keys per master used.

C. Factory stamp all keys "Do not duplicate" and with key symbol as directed by the City of Edinburg Representative. Visual key control shall be provided on all permanent keys and cylinders.

D. Provide keyed construction cores for the duration of the construction phase. Provide twenty (20) construction keys and two (2) construction control keys.

2.06 EXIT DEVICES

A. All exit devices and trim, including electrified items, to be of one manufacturer as hereafter listed and in the hardware sets for continuity of design and consideration of warranty; electrified devices and trim to be the same series and design as mechanical devices and trim.

B. Exit Devices to be "UL" listed for life safety. All exit devices for labeled doors shall have "UL" label for "Fire Exit Hardware". All devices mounted on labeled wood doors are to be through-bolted or per the manufacturer's listing requirements. All devices shall conform to NFPA 80 and NFPA 101 requirements.

C. All exit devices to be of a heavy duty, chassis mounted design, with a one-piece removable cover, eliminating necessity of removing the device from the door for standard maintenance and keying requirements.

D. All trims to be through-bolted to the lock stile case. Lever design to be the same as specified with the lock sets.

E. Exit Devices shall be the modern push rail design. All exit devices shall be mounted with sex bolts and installed with the manufactures standard screws. Exit Hardware Devices found to be installed with self-drilling and self-tapping screws shall be removed and reinstalled at the installer expenses.

F. All devices shall carry a three- (3) year warranty against manufacturing defects and workmanship. Exit devices shall be certified by an independent testing lab for a minimum of 1,000,000 cycles.

G. Furnish roller strikes for all rim and surface vertical rod exit devices. Internal springs shall be coil compression type. Furnish security dead latching for all active latch bolts.

H. All Exit Devices shall be field modifiable as incorporate an Electric Latch Retraction Feature without the purchase of new Panic Exit Hardware.

J. Exit Devices shall be the Von Duprin “99” series device as specified.

2.07 SURFACE MOUNTED DOOR CLOSERS

A. All closers for this project shall be the products of a single manufacturer for continuity of design and consideration of warranty. All door closers shall be mounted as to achieve the maximum degree of opening (trim permitting).

B. All closers to be heavy duty, surface-mounted, fully hydraulic, rack and pinion action with high strength iron cylinder to provide control throughout the entire door opening and closing cycle.

C. Size all closers in accordance with the manufacturer’s recommendations at the factory.

D. All closers to have adjustable spring power sizes 1 or 2 through 4 or 6 and non-critical regulating screw valves for closing speed, latching speed and back-check control as a standard feature unless specified otherwise.

E. Provide closer covers only if provided as a standard part of the door closer package.

F. The hardware supplier shall provide all required brackets, spacers or filler plates as required by the manufacture for a proper and functional installation as part of their base bid.

G. Supply appropriate arm assembly for each closer so that closer body and arm are mounted on non-public side of door opening and on the interior side of exterior openings, except where required otherwise in the hardware sets.

H. Provide drop plates and any additional mounting brackets required for the proper installation of the door closer shall be included in the hardware supplier’s base bid.

I. Finish: Baked on Powder Coated finish shall match other hardware.

J. Provide and mount all door closers with sex bolts as provided by the manufacturer.

K. Closers shall be LCN “4040XP & 1460” series as specified or acceptable products manufactured by Sargent 281 series.

2.08 DOOR STOPS AND HOLDERS

A. Door stops are to be furnished for every door leaf. Every door is to have a floor, wall, or an overhead stop.

B. Place doorstops in such a position that they permit maximum door swing, but do not present a hazard of obstruction. Furnish floor strikes for floor holders of proper height to engage holders of doors.

C. Where overhead stops and holders are specified, or otherwise required for proper door operation, they are to be heavy duty and of extruded brass, bronze or

stainless steel with no plastic parts as specified**.** The General Contractor shall provide wood blocking in all stud walls specified and scheduled to receive wall stops.

D. Finish: Shall match other hardware where available.

E. Acceptable Products

1. Floor and wall stops as listed in hardware sets. Equivalent products as manufactured by Ives, ABH and Trimco are acceptable.

2.09 PUSH PLATES, DOOR PULLS, AND KICKPLATES

A. All push plates, door pull, kick plates and other miscellaneous hardware as listed in hardware sets. Equivalent products as manufactured by Ives, Hager and Trimco are acceptable.

B. Kick plates to be 10 inches high and Mop plates to be 6 inches high, both by 2 inches or 1 inch less than door width (LDW) as specified. They are to be of 16-gauge thick base metal. For door with louvers or narrow bottom rails, kick plate height to be 1 inch less dimension shown from the bottom of the door to the bottom of the louver or glass.

C. Where required armor plates, edge guards and other protective hardware shall be supplied in sizes as scheduled in the hardware sets.

D. Finish: Same as other hardware where available.

2.10 FLUSH BOLTS AND COORDINATORS

A. Provide Flush bolts with Dust Proof Strikes as indicated in the individual hardware sets by Ives, Hager and Trimco are acceptable. Finish shall match the adjacent hardware.

2.11 THRESHOLDS AND SEALS

A. Provide materials and finishes as listed in hardware sets. Zero products have been specified to set a high level of quality, equivalent product by manufactured by National Guard Products and Pemko shall be acceptable. All thresholds must be in accordance with the requirements of the ADA and ANSI A117.1.

B. Provide thresholds with wood screws and plastic anchors. Supply all necessary anchoring devices for weather strip and sound seal.

C. Seals shall comply with requirements of UL10C. All thresholds, door bottoms and weather strip inserts shall be a silicone based product as specified in 3.02 Hardware Sets. Other materials used shall be rejected, unless originally specified.

D. Seals shall comply with the requirements of the Wood Door Manufacturer’s certification requirements.

2.12 FINISHES

A. Finishes for all hardware are as required in this specification and the hardware sets.

B. Special care is to be taken to make uniform the finish of all various manufactured items.

2.13 DOOR SILENCERS

A. Provide door silencers at all openings without gasket. Provide two- (2) each at pair of doors and three- (3) or four- (4) each for each single door (coordinate with the frame manufacturer).

2.14 PROPRIETARY PRODUCTS

A. References to specific products are used to establish quality standards of utility and performance. Unless otherwise approved provide only the specified product.

B. All other materials, not specifically described, but required for a complete and proper finish hardware installation, are to be selected by the Contractor, subject to the approval of the Architect and the City of Edinburg Representative.

C. Architect and the City of Edinburg Representative reserve the right to approve all the substitutions proposed for this specification. All requests for substitution to be made prior to bid in accordance with Division 1, General Requirements, and are to be in writing, hand delivered to the Architect. Two (2) copies of the manufacturer's brochures and a physical sample of each item in the appropriate design and finish shall accompany requests for substitution.

PART 3 - EXECUTION

3.01 INSTALLATION AND SERVICE ITEMS OF FINISH HARDWARE

A. All finish hardware shall be installed by an experienced finish hardware installer with at least ten (10) years of experience after a pre-installation meeting between the contractor, hardware Manufacturers representative, the hardware supplier, the hollow metal supplier and the wood door supplier. The finish hardware installer shall be responsible for the proper installation and function of all doors and hardware.

B. The hardware supplier's office and/or warehouse shall be located within a seventy-five (75) mile radius of the project site as to better service the general contractor and the City of Edinburg Representative during this project.

C. Check hardware against the reviewed hardware schedule upon delivery. Store the hardware in a dry and secure location to protect against loss and damage.

D. Install finish hardware in accordance with approved hardware schedule and manufacturers' printed instructions. Pre-fit hardware before finish is applied to door; remove and reinstall after finish is complete and dry. Install and adjust hardware so that parts operate smoothly, close tightly, and do not rattle.

E. Mortise and cutting to be done neatly, and evidence of cutting to be concealed in the finished work. Protect all Finish hardware from scratching or other damage.

3.02 HARDWARE SETS
SPEXTRA: 424014
HARDWARE GROUP NO. 01 - EXTERIOR ACCESS CONTROLLED - CIRCULATION
FOR USE ON MARK/DOOR #(S):
100

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY-DOOR HEIGHT	628	IVE
1	EA	PANIC HARDWARE	99-L-NL-17-LS-EMB "PUSH"-SNB	US28	VON
1	EA	RIM HOUSING	20-079	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	FSIC CONST. CORE	23-030 ICX	622	SCH
1	EA	ELECTRIC STRIKE	6300 FSE EB	630	VON
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	PA MOUNTING PLATE	4040XP-18PA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	RAIN DRIP	142AA-FRAME WIDTH PLUS 4"	AA	ZER
1	EA	GASKETING	8303AA-S-HEAD & JAMBS	AA	ZER
1	EA	DOOR SWEEP	50MAA-DOOR WIDTH	AA	ZER
1	EA	THRESHOLD	65A-223-FRAME WIDTH	A	ZER
		CARD READER	PROVIDED BY ACCESS CONTROL CONTRACTOR		
		POWER SOURCE	PROVIDED BY ACCESS CONTROL CONTRACTOR		
		WEATHER STRIP	PROVIDED BY THE DOOR MFG		

HARDWARE GROUP NO. 02 - EXTERIOR ACCESS CONTROLLED- CIRCULATION

FOR USE ON MARK/DOOR #(S):
107

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY-DOOR HEIGHT	628	IVE
1	EA	PANIC HARDWARE	99-L-NL-17-LS-EMB "PUSH"-SNB	US28	VON
1	EA	RIM HOUSING	20-079	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	FSIC CONST. CORE	23-030 ICX	622	SCH
1	EA	ELECTRIC STRIKE	6300 FSE EB	630	VON
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA-FRAME WIDTH PLUS 4"	AA	ZER
1	EA	GASKETING	8303AA-S-HEAD & JAMBS	AA	ZER
1	EA	DOOR SWEEP	8197AA-DOOR WIDTH	AA	ZER
1	EA	THRESHOLD	65A-223-FRAME WIDTH	A	ZER
		CARD READER	PROVIDED BY ACCESS CONTROL CONTRACTOR		
		POWER SOURCE	PROVIDED BY ACCESS CONTROL CONTRACTOR		

HARDWARE GROUP NO. 03 - EXTERIOR ACCESS CONTROLLED- ELECTRICAL

FOR USE ON MARK/DOOR #(S):
105

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY-DOOR HEIGHT	628	IVE
1	EA	PANIC HARDWARE	99-L-NL-17-LS-EMB "PUSH"-SNB	US28	VON
1	EA	RIM HOUSING	20-079	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	FSIC CONST. CORE	23-030 ICX	622	SCH
1	EA	ELECTRIC STRIKE	6300 FSE EB	630	VON
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA-FRAME WIDTH PLUS 4"	AA	ZER
1	EA	GASKETING	8303AA-S-HEAD & JAMBS	AA	ZER
1	EA	DOOR SWEEP	8197AA-DOOR WIDTH	AA	ZER
1	EA	THRESHOLD	65A-223-FRAME WIDTH	A	ZER
		CARD READER	PROVIDED BY ACCESS CONTROL CONTRACTOR		
		POWER SOURCE	PROVIDED BY ACCESS CONTROL CONTRACTOR		

HARDWARE GROUP NO. 04 - ACCESS CONTROLLED - LAB, INVENTORY/M.D.F. & CIRCULATION

FOR USE ON MARK/DOOR #(S):
104 106 109

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC STRIKE	8300C-2006M	630	HES
1	EA	STOREROOM LOCK	ND80TD SPA	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	1461 HD FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE
		CARD READER	PROVIDED BY ACCESS CONTROL CONTRACTOR		
		POWER SOURCE	PROVIDED BY ACCESS CONTROL CONTRACTOR		

HARDWARE GROUP NO. 05 - OFFICE

FOR USE ON MARK/DOOR #(S):
108

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRANCE LOCK	ND53TD SPA	626	SCH

1	EA	FSIC CORE	23-030	626	SCH
1	EA	FLOOR STOP	FS410	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 06 - LOCKER ROOM

FOR USE ON MARK/DOOR #(S):
111

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 8" X 16"	630	IVE
1	EA	PULL PLATE	8305 8" 3.5" X 15"	630	IVE
1	EA	SURFACE CLOSER	1461 HD FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 07 - RR1 & RR2

FOR USE ON MARK/DOOR #(S):
101 110

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY W/COIN TURN	L9044 17A L583-363 L283-722	626	SCH
1	EA	SURFACE CLOSER	1461 HDPA FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 08 - MOP SINK & LAB STORAGE

FOR USE ON MARK/DOOR #(S):
102 103

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	ND80TD SPA	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

END OF SECTION

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Float glass.
   2. Tempered glass.
   3. Insulated glass.
   4. Glazing sealants.
   5. Accessories necessary for a complete installation.

1.3 DEFINITIONS

A. Glass Thickness: Indicated by thickness designations in millimeters according to ASTM C 1036.

B. Interspace: Space between lites of an insulating glass unit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design glass panels including comprehensive engineering analysis by a qualified professional engineer lawfully licensed in the State of Texas, using performance requirements and design criteria indicated.

B. Installed Glazing: Design glazing systems to withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
   1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
      a. Wind Design Data: As indicated on Drawings.
      b. Basic Wind Speed: 110 mph (49 m/s).
      c. Importance Factor: 1.0.

   2. Exposure Category: C.
   3. Design Snow Loads: Indicated on Drawings.
   4. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
   5. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
   6. Maximum Lateral Deflection: For glass supported on all four edges, limit center of glass deflection at design wind pressure to not more than 1/50 times the short side length or 1 inch (25 mm), whichever is less.

D. Windborne Debris Impact Resistance: Exterior glazing shall comply with basic-protection testing requirements in ASTM E 1996 for Wind Zone 2 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on Project and shall be installed in same manner as glazing indicated for use on Project.
   1. Large Missile Test: For glazing located within 30 feet (9.1 m) of grade.
   2. Small Missile Test: For glazing located more than 30 feet (9.1 m) above grade.

E. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

F. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
   1. For monolithic glass lites, properties are based on units with lites 6 mm thick.
   2. For laminated glass lites, properties are based on products of construction indicated.
   3. For insulating glass units, properties are based on units of thickness indicated for overall unit and for each lite.
   4. U-Factors: Center of glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
   5. Solar Heat Gain Coefficient and Visible Transmittance: Center of glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
   6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

1.5 SUBMITTALS

A. Product Data: Technical data for each type of product including recommended installation and cleaning procedures.

B. Glass Samples: For each type of glass required. Prepare samples from same material to be used for Work.

C. Glazing Schedule: List glass types and thickness for each size opening and location. Use same designations indicated on Drawings.

D. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Product Certificates: Submit glass product certificates required by Code.
   1. Glass Manufacturer Certificate: The glass manufacturer shall submit a letter certifying it has reviewed the glazing details proposed for the project, including the use of gaskets and sealants, and that each product furnished is recommended for the application shown and compliance with the Code.

F. Thermal Stress and Wind Load Analyses: Submit the following from the glass manufacturer:
   1. Thermal stress analysis for each exterior glass unit type, each building elevation. The analysis shall clearly indicate the expected service temperature ranges and the effects of partial and full shading on the glass.
      a. Attach to the thermal stress analysis a statement from the glass manufacturer that based upon this analysis that the resulting thermal stresses will not reduce the specified statistical probability of breakage.

   2. Wind load analysis for each glass unit type, each building elevation. The analysis shall indicate the statistical probability of breakage at the design wind pressure does not exceed the specified statistical probability of breakage.

G. Product Test Reports: Submit test reports for insulating glass and glazing sealants, for tests performed by a qualified testing agency.
   1. Glazing Sealants: Provide test reports based on testing current sealant formulations within previous 36 month period.
   2. Glazing Sealants: Preconstruction adhesion and compatibility test report.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Building Code: Comply with applicable requirements of the IBC for glazing.

   2. Insulating Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
   3. Glazing Publications: Comply with published recommendations of glass product organizations.
      a. GANA: Glazing Manual.
      b. IGMA: SIGMA TM-3000 Vertical Glazing Guidelines.
      c. GANA: Laminated Glazing Reference Manual.
      d. AAMA: AAMA GDSG-1 Glass Design for Sloped Glazing.
      e. AAMA: TIR A7 Sloped Glazing Guidelines.
      f. IGMA for Sloped Glazing: IGMA TB-3001 Guidelines for Sloped Glazing.
      g. IGMA for Insulating Glass: SIGMA TM-3000 North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use.

   4. Fire Rated Door Assemblies: Assemblies complying with NFPA 80 listed and labeled by UL for fire ratings indicated, based on testing according to NFPA 252.
   5. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
      a. Minimum Glass Thickness for Exterior Lites: 1/4 inch (6 mm).
      b. Thickness of Tinted Glass: Provide same thickness for each tint color indicated.

   6. Strength: Where annealed float glass is indicated, provide annealed float glass, heat strengthened float glass, or fully tempered float glass necessary to comply with performance requirements.
      a. Where heat strengthened float glass is indicated, provide heat strengthened float glass or fully tempered float glass necessary to comply with performance requirements.
      b. Where fully tempered float glass is indicated, provide fully tempered float glass.

B. Manufacturer Qualifications for Insulating Glass Units with Sputter Coated, Low E Coatings: Insulating glass manufacturer who is approved and certified by coated glass manufacturer.

C. Installer Qualifications, Glazer: Experience entity having minimum 5 years documented experience and who employs glass installers certified under the National Glass Association's Certified Glass Installer Program.

D. Installer Qualifications, Decorative Film: Experience entity having minimum 5 years documented experience in the installation of glass films.

E. Source Limitations for Glass and Glass Accessories: Obtain each type of glass and glass accessories from a single source.

F. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

G. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

H. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

I. Install glazing in mockups specified in Section 08 41 13 and Section 08 51 00 to match glazing systems required for Project, including glazing methods.
   1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

J. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass framing member for adhesion to and compatibility with elastomeric glazing sealants.
   1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
   2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
   3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
   4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
   5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

K. Preinstallation Conference: Conduct conference at site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by manufacturer.

D. Exercise exceptional care to prevent edge damage to glass, and damage/deterioration to coating on glass.

E. Comply with insulating glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
   1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 degrees F (4.4 degrees C).

B. Field Measurements: Verify actual dimensions of openings and construction contiguous with decorative glass by field measurements before fabrication.

1.9 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.10 WARRANTY

A. Insulating Glass: Written warranty signed by manufacturer in which manufacturer agrees to replace insulating glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
   1. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Glass:
      a. AGC Glass Company North America, Inc.
      b. Cardinal Glass Industries.
      c. Guardian Industries Corp.; SunGuard.
      d. Oldcastle BuildingEnvelope.
      e. Pilkington North America.
      f. Viracon.

B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 2 (tinted) as indicated, Quality-Q3.
   1. Fabrication Process: By horizontal (roller hearth) process with roll wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

K. Adhered Backing: Adhered scrim backing to ceramic coated surface; provide backed units identical to materials which, while possibly developing cracks and fissures, show no shear nor develop any openings large enough for the unobstructed penetration of 3 inch diameter sphere when tested by approved independent testing laboratory:
   1. Mount test specimens consisting of 3 glass assemblies, 34" x 76" (plus zero or minus 3/16 inch), for testing as specified in ANSI Z-97.1.
   2. Expose specimens to 100 cycles of the following conditions:
      a. 1 hour at 0 degrees F, ambient humidity.
      b. 3 hours increase from 0 degrees F to 140 degrees F, 95 to 100 percent relative humidity.
      c. 1 hour at 140 degrees F, 95 to 100 percent relative humidity.
      d. 3 hours decrease from 140 degrees F to 0 degrees F, ambient humidity.
   3. Break glass by springloaded prick punch at midpoint of either vertical edge.
   4. After breaking glass, subject it to pressure of 4 lbf per sq. ft. for 5 minutes to simulate wind load.
   5. Inorganic Opacifier: Provide polyethylene opacifier where no insulation and other backing material is applied directly to spandrel glass. Use polyester where direct attachment does occur.

6. Fallout Resistance: Provide spandrel units identical to those passing fallout resistance test for spandrel glass specified in ASTM C 1048.

2.2 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
   1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
   2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
   3. Interlayer Thickness: 0.060 inch (1.52 mm).
   4. Interlayer Color: Clear unless otherwise indicated.

B. Windborne Debris Impact Resistant Laminated Glass: Comply with requirements for laminated glass except laminate glass with ionomeric polymer interlayer to comply with interlayer manufacturer's written instructions:

2.3 INSULATING GLASS

A. Insulating Glass Units: Factory assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

B. Performance Properties:
   1. Basis of Design Product: Guardian Global.
   2. Overall Unit Thickness: 1 inch (25 mm).
   3. Minimum Thickness of Each Glass Lite: 1/4 inch (6 mm).
   4. Outdoor Lite: Fully tempered float glass.
   5. Interspace Content: Air.
   6. Indoor Lite: Fully tempered float glass.
   7. Winter Nighttime U-Factor: <**Insert value from manufacturer**> maximum.
   8. Summer Daytime U-Factor: <**Insert value from manufacturer**> maximum.
   9. Safety glazing required.

C. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
   1. Spacer: Aluminum with black, color anodic finish. Manufacturers: Subject to compliance with requirements, provide products by Technoform Glass Insulation NA, Inc.
   1. Desiccant: Molecular sieve or silica gel, or a blend of both.

D. Fire Protection Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire protection ratings indicated, based on positive pressure testing according to NFPA 257 or UL 9, including the hose stream test, and complying with NFPA 80. For ratings 60 minutes or greater, glazing shall meet the test requirements of ASTM E119 or UL 263.

E. Fire Protection Rated Glazing Labeling: Permanently mark fire protection rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction indicating manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether or not glazing has passed the hose-stream test; whether or not glazing meets 450 degrees F (250 degrees C) temperature rise limitation; and the fire resistance rating in minutes.

F. Film Faced Ceramic Glazing: Clear, ceramic flat glass; 5 mm thickness; faced on one surface with a clear glazing film; and complying with 16 CFR 1201, Category II.

2.4 GLASS FILM

A. Performance Requirements:
   1. Scratch resistant coating that, after fully cured, facilitates cleaning without damaging or scratching film.
   2. Optical Distortion: When viewed from a distance of 10 feet at angles up to 45 degrees from either side of the glass, there is no discernable distortion.
   3. Edges: Seal edges except when the film is applied with a lacquer that prevents moisture or free water from penetrating between the film and the glass.

B. Coating: Provide coating with uniform finish, without noticeable pin holes, streaks, thin spots, scratches, or banding.
   1. Light Transmission:
      a. Maximum Variation across Width and Length: Not to exceed 1 percent.
      b. Variation in Transmission across Width and Length: Not to exceed 2 percent.

C. Rate of Change of Total Transmission across Width and Length: Not to exceed 1 percent in 4 inches.

2.5 GLAZING ACCESSORIES

A. Compatibility: Provide glazing sealants compatible with one another and with other materials in contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of service and application, demonstrated by sealant manufacturer based on testing and field experience.

B. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

C. Colors of Exposed Glazing Sealants: Selected by Architect.

D. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Dow Corning Corporation.
      b. GE Construction Sealants; Momentive Performance Materials Inc.
      c. May National Associates, Inc.; a subsidiary of Sika Corporation.
      d. Pecora Corporation.
      e. Sika Corporation.

E. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. BASF Corporation; Construction Systems.
      b. Dow Corning Corporation.
      c. GE Construction Sealants; Momentive Performance Materials Inc.
      d. May National Associates, Inc.; a subsidiary of Sika Corporation.
      e. Pecora Corporation.
      f. Polymeric Systems, Inc.
      g. Sika Corporation.

F. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Bostik, Inc.
      b. Dow Corning Corporation.
      c. GE Construction Sealants; Momentive Performance Materials Inc.
      d. May National Associates, Inc.; a subsidiary of Sika Corporation.
      e. Polymeric Systems, Inc.
      f. Schnee-Morehead, Inc., an ITW company.
      g. Sika Corporation.

G. Glazing Sealant: Acid curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. BASF Corporation; Construction Systems.
      b. Bostik, Inc.
      c. Dow Corning Corporation.
      d. GE Construction Sealants; Momentive Performance Materials Inc.
      e. May National Associates, Inc.; a subsidiary of Sika Corporation.
      f. Pecora Corporation.
      g. Polymeric Systems, Inc.
      h. Schnee-Morehead, Inc., an ITW company.
      i. Sika Corporation.

H. Glazing Sealants for Fire rated Glazing Products: Neutral curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Dow Corning Corporation.
      b. GE Construction Sealants; Momentive Performance Materials Inc.

   2. Colors of Exposed Glazing Sealants: Selected by Architect.

I. Back Bedding Mastic Glazing Tapes: Preformed, butyl based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
   1. AAMA 804.3 tape, where indicated.
   2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
   3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

J. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
   1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
   2 AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

K. Miscellaneous Glazing Accessories: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing

materials for application indicated, and with proven record of compatibility with surfaces contacted in installation.

1. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
2. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
3. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
4. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
5. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
6. Perimeter Insulation for Fire Resistive Glazing: Product approved by testing agency listed and labeled fire resistant glazing product with which it is used for application and fire protection rating indicated.

2.6 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
   a. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

2. Edge and Surface Conditions: Comply with the recommendations of AAMA *Structural Properties of Glass* for clean cut edges, except comply with manufacturer's recommendations.
3. Exposed Glass Edges and Surface Condition: Finish edges flat with an arrissed edge profile (small bevel of uniform width not exceeding 1.5 mm at an angle of approximately 45 degrees to the surface of the glass) with polished (surface is reflective in appearance similar to the major surface of the glass) surface.

B. Cutting: Wheel cut or sawed edges and seamed at manufacturer's option. For site cut glass, provide glass 2 inches (50.8 mm) larger than required in both dimensions to facilitate cutting of clean cut edges without the necessity of seaming or nipping. Do not cut, seam, nip or abrade heat treated glass.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

A. Clean glazing channels and framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
   1. Comply with manufacturer instructions for wiping of surfaces immediately before application of primers.
   2. Wipe metal surfaces with IPA (isopropyl alcohol) unless otherwise required by compatibility and adhesion testing results.

B. Inspect each piece of glass immediately before installation. Do not install pieces improperly sized or with damaged edges, scratches, abrasion, or evidence damage. Remove labels from glass immediately after installation.

C. Examine glazing units to locate exterior surface. Label or mark units so exterior surface are readily identifiable. Do not use materials that leave visible marks in the completed Work.

D. Seal vent (breather or capillary) tubes in insulating glass units in accordance with insulating glass manufacturer written recommendations.

3.3 GLAZING

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8 inch (3 mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior as specified.

J. Where wedge shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
   1. Square cut wedge shaped gaskets at corners and install gaskets as recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

K. Tape Glazing: Position tapes on fixed stops so that, when compressed by glass, the exposed edges are flush with or protrude slightly above sightline of stops.
   1. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make tapes fit opening.
   2. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
   3. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
   4. Do not remove release paper from tape until right before each glazing unit is installed.
   5. Apply heel bead of elastomeric sealant.
   6. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
   7. Apply cap bead of elastomeric sealant over exposed edge of tape.

L. Gasket Glazing (Dry): Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
   1. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
   2. Installation with Drive in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
   3. Installation with Pressure Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
   4. Install gaskets to protrude past face of glazing stops.

M. Sealant Glazing (Wet): Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
   1. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
   2. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

N. Structurally Glazed Units: Set full height continuous structural gaskets/spacers to vertical mullions. Set glass units with void between edge of units and head/sill channel, but with units fully within head/sill rebate so as to provide a proper bite.
   1. Align glass unit edges over vertical mullion continuous structural gasket/spacers and secure with manufacturers recommended temporary cleats.
   2. Structurally seal glass unit to vertical mullions with specified one part structural silicone sealant. Tool structural silicone flush in alignment to mullion face and perpendicular to

face of interior glass light; remove excess structural silicone from glass and metal substrates.

3. After full cure of structural silicone sealant remove temporary cleats. Immediately seal holes left in the vertical mullions caused by temporary cleats.
4. Insert and shape weatherseal joint backer rods, or gaskets, into vertical void between glass units and at a proper depth to receive silicone weatherseal sealant.
5. Place silicone weatherseal sealant into void and tool flush with adjacent exterior glass light faces; remove excess sealant from glass and metal substrates.

O. Erection Tolerances:
1. Maximum Deviation from Vertical: 1/8 inch in any story and 1/4 inch in any 45 foot run.
2. Maximum Deviation from Horizontal: 1/8 inch in any 30 foot run.
3. Maximum Deviation from True Alignment: 1/32 inch for any two (2) abutting units. Allow no edge projections.
4. Maximum Joint Gap: 1/32 inch.

3.4 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
1. If contaminating substances come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

PART 4 – SCHEDULE

4.1 GLAZING SCHEDULE

A. G-1 Insulated Glass: 1 inch (25 mm) sealed insulated unit consisting of an exterior lite of 1/4 inch (6 mm) low-e tinted tempered float glass, 1/2 inch gas filled air space, and 1/4 inch (6 mm) clear tempered float glass interior lite.

END OF SECTION 08 80 00

SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Gypsum Board.
   2. Partition Framing Systems.
   3. Reinforced Gypsum Board Sheathing (Tile Backer Board).
   4. Ceiling Suspension Systems.
   5. Accessories necessary for a complete installation.

1.3 PERFORMANCE REQUIREMENTS

A. Performance Requirements: Comply with manufacturer's load tables and the following design pressures and deflections:
   1. Stairs, Elevator Hoistways, and Vertical Shafts: 1/120 at 10 psf.
   2. Ground Floor Lobbies: 1/120 at 15 psf.
   3. Partitions Receiving Stone Cladding, Lath and Plaster, or Plaster Veneer: 1/360 at 15 psf.
   4. Partitions Receiving Monitors, Televisions, Heavy Audio/Visual Equipment: 1/360 at 15 psf.
   5. Typical Partitions: 1/240 at 5 psf.
   6. Other Partitions: 1/240 at 5 psf.
      a. Maximum Deflection:
         1) L/240 at 5 lbf per sq. ft.
         2) L/120 at 5 lbf per sq. ft.
         3) L/120 at 7.5 lbf per sq. ft.
         4) L/120 at 10 lbf per sq. ft.

B. Fire Resistance Rated Assemblies: For fire resistance rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

C. STC Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

1.4 SUBMITTALS

A. Product Data: Submit For each type of drywall including calculations for loadings and stresses of exterior walls and specially fabricated framing based on manufacturer’s load tables.

B. Shop Drawings: Indicate locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.

C. Samples:

1. Trim Accessories: Full size Sample in 12 inch (300 mm) long length for each trim accessory indicated.
2. Textured Finishes: 12 inch by 12 inch (300 mm by 300 mm) for each textured finish indicated and on same backing indicated for Work.

D. Calculations: Submit calculations verifying steel partition stud minimum base metal thickness and depth compliance with Code and ASTM C645 for height, load, and deflection.

E. Evaluation Reports: ICC-ES reports for dimpled steel studs and runners and firestop tracks.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Comply with applicable requirements of IBC for interior finishes.
2. Fire Resistance Rated Assemblies: For fire resistance rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. Single Source Responsibility:
1. Framing Members: Obtain steel framing members from single manufacturer.
2. Panel Products: Obtain each type of gypsum board and other panel products from single manufacturer.
3. Finishing Materials: To the extent possible, obtain finishing materials from same manufacturer supplying gypsum board products. When not possible, obtain materials from manufacturer acceptable to gypsum board manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 for gypsum board manufacturer's written instructions, whichever are more stringent.
1. Do not install paper faced gypsum panels until installation areas are enclosed and conditioned.

B. Room Temperatures: Maintain minimum 40 degrees F (4 degrees C). For adhesive attachment and finishing of gypsum board, maintain minimum 50 degrees F (10 degrees C) for 48 hours before application and continuously after until dry. Do not exceed 95 degrees F (35 degrees C) when using temporary heat sources.

C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

D. Do not install panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Steel Studs and Tracks:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) ClarkDietrich
         2) CEMCO; California Expanded Metal Products Co.
         3) Custom Stud.
         4) MBA Building Supplies.
         5) MRI Steel Framing, LLC.
         6) Phillips Manufacturing Co.
         7) Steel Network, Inc. (The).
         8) Telling Industries.

   2. Ceiling Grid:
      a. Armstrong World Industries, Inc.; Drywall Grid Systems.
      b. Chicago Metallic Corporation; 640-C.
      c. CertainTeed Corporation.
      d. USG Corporation; Drywall Suspension System.

   3. Gypsum Board:
      a. Certainteed Corporation.
      b. Georgia Pacific.
      c. National Gypsum Company.
      d. USG Corporation.

   4. Tile Backer Board: Fiberock Interior Aqua-Tough; USG Corporation or comparable product.

   5. Glass Mat Gypsum Sheathing Board:
      a. CertainTeed Corporation; GlasRoc.
      b. G-P Gypsum Corporation; Dens-Glass Gold.
      c. National Gypsum Company; Gold Bond e(2)XP.
      d. United States Gypsum Co.; Securock.

   6. Base Trim:
      a. Waterguard.
      b. Substitutions, refer to Division 1.

B. Framing Members: ASTM C 754 for component sizes and conditions under specified maximum deflection and lateral loading conditions indicated.
   1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal.
   2. Protective Coating: ASTM A 653/A 653M, G60 (Z180), hot dip galvanized.

C. Steel Framing Components: ASTM C 754 for conditions indicated; hot dip galvanize complying with ASTM A 653M Z180.
   1. Steel Studs and Runners: ASTM C 645, 0.0179 inch (0.45 mm) minimum base metal thickness; Depth indicated on Drawings.
   2. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
   3. Cold Rolled Channel Bridging: 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges. Depth indicated on Drawings.

4. Clip Angle: Not less than 1-1/2 inches by 1-1/2 inches (38.1 mm by 38.1 mm), 0.068 inch (1.73 mm) thick, galvanized steel.
5. Hat Shaped, Rigid Furring Channels: ASTM C 645; 0.0179 inch (0.45 mm) minimum base metal thickness; Depth indicated on Drawings.
6. Resilient Furring Channels: 1/2 inch (12.7mm) deep, steel sheet members designed to reduce sound transmission. Configuration: Asymmetrical or hat shaped.
7. Cold Rolled Furring Channels: 0.0538 inch (1.37mm) bare steel thickness, with minimum 1/2 inch (12.7mm) wide flanges.
    a. Depth: Indicated on Drawings.
    b. Furring Brackets: Adjustable, corrugated edge type of steel sheet with minimum bare steel thickness of 0.0312 inch (0.79 mm).
    c. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625 inch (1.59mm) diameter wire, or double strand of 0.0475 inch (1.21mm) diameter wire.
8. Z Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.
9. Auxiliary Framing Materials: Fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
10. Slip Type Head Joints: Where indicated, provide one of the following:
    a. Single Long Leg Runner System: ASTM C 645 top runner with 2 inch (50.8 mm) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging, located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
    b. Double Runner System: ASTM C 645 top runners, inside runner with 2 inch (50.8 mm) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
    c. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs. Provide one of the following:
        1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
        2) Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
        3) Superior Metal Trim; Superior Flex Track System (SFT).
11. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire resistance rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs. Provide one of the following:
    a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
    b. Grace Construction Products; FlameSafe FlowTrak System.
    c. Metal-Lite, Inc.; The System.
    d. Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series as applicable.

D. Ceiling Suspension Components:
1. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625 inch (1.59 mm) diameter wire, or double strand of 0.0475 inch (1.21 mm) diameter wire.
2. Hanger Attachments to Concrete:
    a. Anchors: Postinstalled, chemical anchor or postinstalled, expansion anchor fabricated from corrosion resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
    b. Powder Actuated Fasteners: Suitable for application indicated, fabricated from corrosion resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that

imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

3. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162 inch (4.12 mm) diameter.
4. Carrying Channels: Cold rolled, commercial steel sheet with base metal thickness of 0.0538 inch (1.37 mm) and minimum 1/2 inch (12.7 mm) wide flanges. Depth indicated on Drawings.
5. Furring Channels (Furring Members):
   a. Cold Rolled Channels: 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges, 3/4 inch (19.1 mm) deep.
   b. Steel Studs: ASTM C 645; minimum base metal thickness of 0.0312 inch (0.79 mm); Depth indicated on Drawings.
   c. Hat Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep; Minimum base metal thickness of 0.0312 inch (0.79 mm).
6. Resilient Furring Channels: 1/2 inch (12.7 mm) deep members designed to reduce sound transmission. Configuration: Hat shaped.
7. Grid Suspension System for Ceilings: ASTM C 645, direct hung system composed of main beams and cross furring members that interlock.

E. Gypsum Board: ASTM C 1396/C 1396M, applicable to type of gypsum board indicated and whichever is more stringent.
   1. Core: Use Type X throughout
      a. Thickness: 5/8 inch (15.9 mm).
      b. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
   2. Ceiling Type: Manufactured for sag resistance
      a. Thickness: 1/2 inch (13mm).
      b. Long Edges: Tapered.
   3. Moisture and Mold Resistant Type: Type X with moisture and mold resistant core and surfaces. Core:
      a. Thickness: 5/8 inch (15.9 mm).
      b. Long Edges: Tapered.

F. Reinforced Gypsum Sheathing (Tile Backer Board): ASTM C 1278/C 1278M, standard edges. Cellulose fiber reinforced panels may be used in lieu of cementitious board.
   1. Core and Thickness: 1/2 inch (12.7 mm) or 5/8 inch (15.9 mm) to match conditions, Type X.
   2. Long Edge: Tapered.
   3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

G. Glass Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M, with fiberglass mat laminated to both sides and with standard edges.
   1. Thickness: 1/2 inch (12.7 mm).
   2. Size: 48 inches by 96 inches (1219 mm by 2438 mm).
   3. Long Edges: Tapered.

H. Fire rated, Glass Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M, with fiberglass mat laminated to both sides and with standard edges.
   1. Core: Type X
   2. Thickness: 5/8 inch (15.9 mm).
   3. Size: 48 inches by 96 inches (1219 mm by 2438 mm).
   4. Long Edges: Tapered.

I. Base Trim:
   1. Poly Vinyl Chloride (PVC) compound meeting the requirements of ASTM C1047. ASTM D3678, ASTM D3679, and ASTM D4216.
   2. Sizes:
      a. 1/2 inch (12.7 mm) height X 1/2 inch (12.7 mm) depth or 1/2-inch (12.7 mm) X 5/8 inch (15.875 mm).

J. Exterior Trim: ASTM C 1047, hot dip galvanized steel sheet, plastic, or rolled zinc.
   1. Shapes:
      a. Cornerbead.
      b. LC Bead: J shaped; exposed long flange receives joint compound.
      c. Expansion (Control) Joint: One piece, rolled zinc with V shaped slot and removable strip covering slot opening.

K. Interior Trim: ASTM C 1047; galvanized or aluminum coated steel sheet, rolled zinc, plastic, or paper faced galvanized steel sheet.
   1. Poly Vinyl Chloride (PVC) compound meeting the requirements of ASTM C1047. ASTM D3678, ASTM D3679, and ASTM D4216.
   2. Shapes:
      a. Cornerbead.
      b. Bullnose bead.
      c. LC Bead: J shaped; exposed long flange receives joint compound.
      d. L Bead: L shaped; exposed long flange receives joint compound.
      e. U Bead: J shaped; exposed short flange does not receive joint compound.
      f. Expansion (control) joint.

   3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Fry Reglet Corp.
      b. Gordon, Inc.
      c. Pittcon Industries.

L. Continuous Corner: Extruded Aluminum; continuous integral fin for surface contact with gypsum board; 7/8 inch (22 mm) wide, tapered to edge; punched with holes staggered to accept screw fastening. Prime with corrosion resistant primer. Provide Pittcon Softforms SO-HSE-90 or Schluter.
   1. Basis of Design: Pittcon Softforms SO-HSE-90; Subject to compliance with requirements, provide basis of design or comparable by one of the following:
      a. Fry Reglet Corporation.
      b. Pittcon Industries.
      c. Schluter.

M. Joint Treatment: ASTM C 475/C 475M.
   1. Joint Tape:
      a. Exterior Gypsum Soffit Board: Paper.
      b. Joint Compound for Exterior Applications, Glass Mat Gypsum Sheathing Board: Recommended by sheathing board manufacturer.
      c. Joint Tape, Interior Gypsum Board: Paper.

   2. Joint Compound:
      a. Gypsum Board: Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting type taping compound.
         1) Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting type taping compound.
            a) Use setting type compound for installing paper faced metal trim accessories.

2) Fill Coat: For second coat, use setting type, sandable topping compound.
3) Finish Coat: For third coat, use setting type, sandable topping compound.
4) Skim Coat: For final coat of Level 5 finish, use setting type, sandable topping compound.

b. Cementitious Units: Recommended by backer unit manufacturer.
c. Tile Backing Panels: Recommended by backer unit manufacturer.
d. Water Resistant Gypsum Backing Board: Use setting type taping compound and setting-type, sandable topping compound.
e. Joint Compound, Glass Mat Sheathing Board: Recommended by sheathing board manufacturer.

N. Auxiliary Gypsum Materials: Comply with referenced installation standards and manufacturer's written recommendations.
1. Steel Drill Screws: ASTM C 1002, use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
a. Fire Resistance Rated Assemblies: Comply with mineral-fiber requirements of assembly.

3. Control Joints: Metal (USG #093 / Dietrich 093 Control Joint) type with 1/4 inch open joint, perforated flanges for floating in place.
4. Acoustical Sealant: Nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Hilti, Inc.
2) Pecora Corporation.
3) Specified Technologies, Inc.
4) United States Gypsum Company.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow metal frames, cast in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION

A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.

B. Gypsum Board Assemblies: Comply with requirements in ASTM C 840 applicable to framing installation.

C. Control joints shall be located 30 feet-0 inches on center maximum and along building expansion joints, unless noted otherwise on drawings. Locations shall be reviewed with Architect prior to final placement.

D. Suspension System: Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
   1. Suspend hangers from building structure:
      a. Install hangers plumb and free from contact with insulation or objects within ceiling plenum that are not part of supporting structural or suspension system. Splay hangers where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
      b. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
         1) Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

      c. Do not attach hangers to steel roof deck.
      d. Do not attach hangers to permanent metal forms. Furnish cast in place hanger inserts that extend through forms.
      e. Do not attach hangers to rolled in hanger tabs of composite steel floor deck.
      f. Do not connect or suspend steel framing from ducts, pipes, or conduit.
   2. Fire Resistance Rated Assemblies: Wire tie furring channels to supports.
   3. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross furring members to each other and butt cut to fit into wall track.

F. Framing Assembly: Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
   1. Install studs so flanges within framing system point in same direction. Space studs in single layer application as indicated on drawings.
   2. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
      a. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
         1) Install two studs at each jamb, unless otherwise indicated.
         2) Install cripple studs at head adjacent to each jamb stud, with minimum 1/2 inch (12.7mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
         3) Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

      b. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

3. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

G. Gypsum Panels: Comply with ASTM C 840. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
   1. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
   2. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
   3. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
   4. Form control and expansion joints with space between edges of adjoining gypsum panels.
   5. Cover both faces of support framing with gypsum panels in concealed spaces, except in chases braced internally.
      a. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
      b. Fit gypsum panels around ducts, pipes, and conduits.
      c. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4 inch to 3/8 inch (6.4 mm to 9.5 mm) wide joints to install sealant.

   6. Isolate perimeter of gypsum board applied to nonload bearing partitions at structural abutments, except floors. Provide 1/4 inch to 1/2 inch (6.4mm to 12.7mm) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
   7. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

H. Gypsum Board: Install interior gypsum board where indicated on drawings.
   1. Single Layer Application:
      a. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
      b. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire resistance rated assembly, and minimize end joints. Stagger abutting end joints not less than one framing member in alternate courses of panels.
      c. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

   2. Multilayer Application:
      a. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
      b. On Z shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
      c. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

I. Backing Panels:
   1. Cementitious Backer Units: ANSI A108.11; install where indicated with 1/4 inch (6.4 mm) gap where panels abut other construction or penetrations. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

J. Trim Accessories: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Attach trim according to manufacturer's written instructions.
   1. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
   2. Exterior Trim: Install in the following locations:
      a. Cornerbead: Use at outside corners.
      b. LC Bead: Use at exposed panel edges.

   3. Interior Trim: Install in the following locations:
      a. Cornerbead: Use at outside corners, unless otherwise indicated.
      b. Bullnose Bead: Use at outside corners.
      c. LC Bead: Use at exposed panel edges.
      d. L Bead: Use where indicated or necessary.
      e. U Bead: Use at exposed panel edges.

K. Gypsum Board Finishing: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
   1. Prefill open joints, rounded or beveled edges, and damaged surface areas.
   2. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
   3. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
      a. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
      b. Level 2: Panels that are substrate for tile.
      c. Level 3: Surfaces be coated with drywall primer prior to final finishes. Heavy or medium texture finishes before final painting, or where heavy-grade wall coverings are to be applied as the final decoration. This level of finish is not recommended where smooth painted surfaces, or light to medium weight wall coverings as specified.
      d. Level 4: For surfaces receiving wall covering and flat paints.
      e. Level 5: For surfaces receiving gloss or semigloss paint and surfaces subjected to severe lighting.

   4. Glass Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
   5. Glass Mat Faced Panels: Finish according to manufacturer's written instructions.

L. Installation Tolerances:
   1. Suspension System: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.
   2. Installation Tolerances, Suspension System: Install suspension systems level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.
   3. Float Control Joints flush with wall surface so that ceiling wall mold specified separately will align with wall surface flat and straight.

3.4 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 21 16

SECTION 09 24 00 - CEMENT PLASTERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Exterior plasterwork (stucco).
   2. Metal framing and accessories.
   3. Metal lath and furring.
   4. Accessories necessary for a complete installation.

1.3 SUBMITTALS

A. Product Data: Submit technical data for product and accessory, including construction details and material descriptions.

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Building Code: Comply with applicable provisions of the IBC and the IECC for building enclosures.
   2. Fire Resistance Ratings: Where indicated, provide cement plaster assemblies identical to those of assemblies tested for fire resistance according to ASTM E 119 by a qualified testing agency.

B. Preinstallation Conference: Conduct conference at site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver cementitious materials in original packages, containers, or bundles, labeled with manufacturer's name, product brand name, and lot number.

B. Store materials inside under cover, and keep them dry and protected against damage from weather, moisture, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.6 PROJECT CONDITIONS

A. Comply with applicable requirements of ASTM C 926.

B. Environmental Requirements: Comply with requirements of referenced plaster application standards and recommendations of plaster manufacturer for environmental conditions before, during, and after plaster application.

C. Cold Weather Requirements: Provide heat and protection, temporary or permanent, as required to protect each coat of plaster from freezing for at least 24 hours after application. Distribute heat uniformly to prevent concentration of heat on plaster near heat sources; provide deflection or protective screens.

D. Warm Weather Requirements: Protect plaster against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial. Apply and cure plaster as required by climatic and job conditions to prevent dry out during cure period. Provide suitable coverings, moist curing, barriers to deflect sunlight and wind, or combinations of these, as required.

E. Ventilation: Provide natural or mechanical means of ventilation to properly dry interior spaces after portland cement plaster has cured.

F. Exterior Plasterwork:
1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
2. Apply plaster when ambient temperature is greater than 40 degrees F (4.4 degrees C).
3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.

G. Protect contiguous Work from soiling and moisture deterioration caused by plastering. Provide temporary covering and take precautions necessary to minimize spattering of plaster on adjacent Work.

H. Factory Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
1. Metal Lath and Accessories:
   a. Alabama Metal Industries.
   b. CEMCO.
   c. ClarkDietrich Building Systems.
   d. Marino/WARE.
   e. Phillips Manufacturing.

2. Plastic Accessories:
   a. Alabama Metal Industries.
   b. Phillips manufacturing.
   c. Plastic Components.
   d. Vinyl Corp.

3. Ready Mixed Finish Coat Plaster:
   a. California Stucco Product.
   b. El Rey Solutions.
   c. Florida Stucco.
   d. Omega Products International.
   e. Quikrete.
   f. Shamrock Stucco.

4. Acrylic Based Finish Coat:
    a. California Stucco Product.
    b. Dryvit Systems.
    c. El Rey Solutions.
    d. Finestone, BASF Corp.
    e. Omega Products International.
    f. Senergy, BASF Corp.
    g. Sto Corp.

B. Cold Formed Steel Framing: Refer to Section 05 40 00 for steel framing for exterior plaster (stucco).

C. Steel Studs and Runners: Refer to Section 09 21 16 for steel partition framing for interior plaster.

D. Soffit Framing: Refer to Section 05 40 00.

E. Metal Lath:
1. Expanded Metal Lath: ASTM C 847, cold rolled carbon steel sheet with ASTM A 653/A 653M, G60 (Z180), hot dip galvanized zinc coating.
    a. Diamond Mesh Lath: Self furring, 3.4 lb/sq. yd. (1.8 kg/sq. m).

F. Accessories: Comply with ASTM C 1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.
1. Metal Accessories:
    a. Foundation Weep Screed: Fabricated from hot dip galvanized steel sheet, ASTM A 653/A 653M, G60 (Z180) zinc coating.
    b. Cornerite: Fabricated from metal lath with ASTM A 653/A 653M, G60 (Z180), hot dip galvanized-zinc coating.
    c. Outside Corner Reinforcement: Fabricated from metal lath with ASTM A 653/A 653M, G60 (Z180), hot dip galvanized zinc coating.
    d. Cornerbeads: Fabricated from zinc or zinc coated (galvanized) steel.
        1) Smallnose cornerbead with expanded flanges; use unless otherwise indicated.
        2) Smallnose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.

    e. Casing Beads: Fabricated from zinc or zinc coated (galvanized) steel; square edged style; with expanded flanges.
    f. Control Joints: Fabricated from zinc or zinc coated (galvanized) steel; one piece type, folded pair of unperforated screeds in M shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
    g. Expansion Joints: Fabricated from zinc or zinc coated (galvanized) steel; folded pair of unperforated screeds in M shaped configuration; with expanded flanges.
    h. Two Piece Expansion Joints: Fabricated from zinc or zinc coated (galvanized) steel; formed to produce slip joint and square edged reveal adjustable from 1/4 to 5/8 inch (6 to 16 mm) wide; with perforated flanges.

2. Plastic Accessories: Manufactured from high impact PVC.
    a. Cornerbeads: With perforated flanges.
        1) Smallnose cornerbead; use unless otherwise indicated.
        2) Bullnose cornerbead, radius 3/4 inch (19 mm) minimum; use at locations indicated on Drawings.

    b. Casing Beads: With perforated flanges in depth required to suit plaster bases indicated and flange length required to suit applications indicated.

1) Square edge style; use unless otherwise indicated.
2) Bullnose style, radius 3/4 inch (19 mm) minimum; use at locations indicated on Drawings.

c. Control Joints: One piece type, folded pair of unperforated screeds in M shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
d. Expansion Joints: Two piece type, formed to produce slip joint and square edged 1 inch (25 mm) wide reveal; with perforated concealed flanges.

G. Miscellaneous Materials:
1. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
2. Fiber for Base Coat: Alkaline resistant glass or polypropylene fibers, 1/2 inch (13 mm) long, free of contaminants, manufactured for use in cement plaster.
3. Bonding Compound: ASTM C 932.
4. Fasteners for Attaching Metal Lath to Substrates: ASTM C 1063.
5. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
a. Fire Resistance Rated Assemblies: Comply with mineral-fiber requirements of assembly.

H. Plaster Materials:
1. Portland Cement: ASTM C 150/C 150M, Type I.
a. Color for Finish Coats: Match existing.

2. Colorants for Job Mixed Finish Coats: Colorfast mineral pigments that produce finish plaster color selected by Architect.
3. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.
4. Sand Aggregate: ASTM C 897.
a. Color for Job Mixed Finish Coats: White**.**

5. Exposed Aggregates for Finish Coats: Match existing.
6. Ready Mixed Finish Coat Plaster: Mill mixed portland cement, aggregates, coloring agents, and proprietary ingredients.
a. Color: Selected by Architect.

7. Acrylic Based Finish Coatings: Factory mixed acrylic emulsion coating systems formulated with colorfast mineral pigments and fine aggregates; for use over cement plaster base coats. Include manufacturer's recommended primers and sealing topcoats for acrylic based finishes.
a. Color: Selected by Architect.

2.2 PLASTER MIXES

A. Comply with ASTM C 926 for applications indicated.
1. Fiber Content: Add fiber to base coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. yd. (0.6 kg of fiber/cu. m) of cementitious materials.

B. Base Coat Mixes for Use over Metal Lath: Scratch and brown coats for three coat plasterwork:
1. Portland Cement Mix:
a. Scratch Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.

b. Brown Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.

C. Job Mixed Finish Coat Mixes:
1. Portland Cement Mix: For cementitious materials, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 1-1/2 to 3 parts aggregate per part of cementitious material.

D. Factory Prepared Finish Coat Mixes: For ready mixed finish coat plasters or acrylic based finish coatings, comply with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

A. Protect adjacent Work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

B. Prepare smooth, solid substrates for plaster according to ASTM C 926.

3.3 INSTALLATION

A. Metal Lath: Install according to ASTM C 1063.
1. Partition Framing and Vertical Furring: Flat diamond mesh lath.
2. Horizontal Framing: Flat diamond mesh lath.

B. Accessories: Install according to ASTM C 1063 and at locations indicated on Drawings.
1. Reinforcement for External (Outside) Corners:
a. Install [lath type, external corner reinforcement] [cornerbead] at exterior locations.
b. Install cornerbead at interior locations.

2. Control Joints: Locate as approved by Architect for visual effect:
a. As required to delineate plasterwork into areas (panels) of the following maximum sizes:
1) Vertical Surfaces: 144 sq. ft. (13.4 sq. m).
2) Horizontal and Other Nonvertical Surfaces: 100 sq. ft. (9.3 sq. m).

b. At distances between control joints of not greater than 18 feet (5.5 m) o.c.
c. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
d. Where control joints occur in surface of construction directly behind plaster.
e. Where plasterwork areas change dimensions, to delineate rectangular shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.4 PLASTER APPLICATION

A. Comply with ASTM C 926.

1. Do not deviate more than plus or minus 1/4 inch in 10 feet (6 mm in 3 m) from a true plane in finished plaster surfaces when measured by a 10-foot (3-m) straightedge placed on surface.
2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
3. Provide plaster surfaces ready to receive field applied finishes indicated.

B. Flat Surface Tolerances: Do not deviate more than plus or minus 1/8 inch in 10 feet (3 mm in 3 m) from a true plane in finished plaster surfaces, measured by a 10 foot (3m) straightedge placed at any location on surface.

C. Walls; Base Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three coat plasterwork with 3/4 inch (19 mm) total thickness:
1. Portland cement mixes.

D. Plaster Finish Coats: Apply to provide dash finish.

E. Acrylic Based Finish Coatings (Contractor Option to Plaster Finish Coat): Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.

F. Concealed Exterior Plasterwork: Where plaster application is used as a base for adhered finishes, omit finish coat.

3.5 PLASTER REPAIRS

A. Repair or replace Work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

B. Cut, patch, replace, repair, and point up plaster as necessary to accommodate other Work. Repair cracks and indented surfaces. Point up finish plaster surfaces around items that are built into or penetrate plaster surfaces. Repair or replace Work to eliminate blisters, buckles, check cracking, dry outs, efflorescence, excessive pinholes, and similar defects. Repair or replace work as necessary to comply with required visual effects.

3.1 TOLERANCES

A. Maximum Variation from True Lines and Levels: 1/8 inch in 10 feet (3mm in 3 m).

B. Maximum Variation from True Position: 1/8 inch (3mm).

3.2 CLEANING AND PROTECTION

A. Remove temporary protection and enclosure of Work after plastering is complete. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

B. Remove unused materials, containers, equipment, and plaster debris.

C. Protect plaster and maintain conditions ensuring finished plaster is without damage or deterioration at time of Substantial Completion.

END OF SECTION 09 24 00

SECTION 09 30 13 - CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Thin set glazed wall and floor tile, base and necessary trim shapes, mortar and grout, expansion joints, sealants, transition strips, and accessories shown or required to complete work.

1.3 RELATED SECTIONS

A. Section 09 65 13 – Resilient Base.

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with values determined by testing identical products per ASTM C 1028:
   1. Level Surfaces: Minimum 0.6.
   2. Ramp Surfaces: Minimum 0.8.

1.5 SUBMITTALS

A. Product Data: Technical data including data sheets, installation recommendation, and recommended joint widths.

B. Shop Drawings: Show locations of each type of tile and tile pattern.
   1. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples: Submit samples showing full range of color and texture variations expected.
   1. Full size units of each type and composition of tile and for each color and finish required.
   2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required; minimum 12 inches (300 mm) square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
   3. Waterproof membrane in 6 x 6-inch sample.
   4. Thresholds in 6 inch (150 mm) lengths.

D. Test Reports: Submit test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of tile products with requirements for slip resistance.

E. Maintenance Instructions: Submit maintenance instructions for each type of product specified.

F. Certifications:
   1. Provide Master Grade Certificate as specified in ANSI A137.1.
   2. Manufacturer’s affidavits that materials used contain no asbestos.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Building Code: Comply with applicable requirements for the IBC for interior finishes.
   2. Surface Burning Characteristics: ASTM E 84; identify products with appropriate markings of applicable testing agency.
      a. Flame Spread Index: 25 or less.
      b. Smoke Developed Index: 450 or less.

   3. Accessibility Requirements: Comply with applicable requirements.
      a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
      b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
      c. Texas Accessibility Standards (TAS) 2012.

B. Source Limitations for Tile: Obtain tile of same type and color or finish from one source or producer. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

D. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:
   1. Stone thresholds.
   2. Waterproofing.
   3. Joint sealants.
   4. Cementitious backer units.
   5. Metal edge strips.

E. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products. Contractor shall provide certified moisture testing results per ASTM F2170 (*Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes*) to Architect and Owner prior to floor installation. Acceptable moisture content of concrete sub floor shall be within approved manufacture limits or lower prior to installation.

F. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockup of each type of floor tile installation.
   2. Build mockup of each type of wall tile installation.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided. Store liquid materials in unopened containers and protected from freezing.

C. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

B. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products.

C. Maintain temperatures at 50 degrees F or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Tile and Trim Units: Furnish quantity of full size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
   2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.10 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 13 – Project Coordination.

1.11 WARRANTY

A. Warrant the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

B. Defects shall include, but not be limited to, the following:
   1. Damaged tile, including broken or chipped edges.
   2. Loose or missing tile.
   3. Noticeable deterioration or discoloring of tile or grout.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers listed whose product meets or exceed the specifications may be used on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions in order to be considered.

B. Basis of Design Product: Concept Surfaces & Interceramic series, pattern, and color selections are indicated in the Construction Documents and are a basis of design. Subject to compliance with requirements, provide product indicated in Construction Documents or comparable product

by one of the following:

Exterior: Concept Surfaces 8”x16” Gris Zingue 03
Interior Field Wall Tile: Interceramic Burano Bianco Valetta 12”x24” with 3”x12” bullnose
Accent Tile: Interceramic Retro Sapphire 8”x8”

1. Ceramic Tile:
   a. Interceramic, USA; (800) 496-8453
   b. Concept Surfaces; (972) 386-4900
   c. American Olean Tile Co.; (214) 398-1411.
   d. American Tile; (713) 939-1077.
   e. Dal-Tile Corp.; (713) 481-5893.
   f. American Marazzi Tile, Inc.; (972) 226-0110.
   g. United States Ceramic Tile Co.; (800) 321-0684.

2. Tile Setting and Grout Materials: Those manufactured by the approved tile manufacturers named above or any of the following as approved by the tile manufacturer for use with his tile and to suit application.
   a. Custom Building Products, Seal Beach, CA; (562) 598-8808
   b. Dal-Tile Corp., Dallas, TX; (713) 481-5893
   c. Laticrete International, Inc., Bethany, CT; (800) 243-4788
   d. MAPEI Corp, Deerfield Beach, FL; (954) 246-8888

2.2 INTERIOR TILES

A. Ceramic Tile:
   1. Floor Tile:
      a. Type/Size: Non-glazed 2 inch by 2 inch ceramic mosaic tile, with cushion edge.
      b. Base: Cove type to match floor tile type and size.
      c. Colors: As selected by Architect from manufacturer’s available colors, but for pricing purposes, Offerors may use 25 percent from the fourth most expensive price group, 25 percent from the third most expensive price group, 25 percent from the second most expensive price group, 25 percent from the least expensive price group.
      d. Pattern(s): Moderate complexity patterns as selected by Architect. Allow for angles and cutting of tiles.

   2. Wall Tile:
      a. Type/Size: Bright or matte glazed 4-1/4 inch by 4-1/4 inch ceramic tile, with cushion edge.
      b. Shapes: Provide necessary trim shapes to terminate tile with a bullnose edge and rounded external corners. Provide square internal vertical corners and ceiling - wall joints. Provide built-up cove base at showers as shown or required.
      c. Colors: As selected by Architect from manufacturer’s available colors, but for pricing purposes, Offerors may use 40 percent from Price Group I, 20 percent from Price Group II, 20 percent from Price Group III, 20 percent from Price Group IV.
      d. Pattern(s): Moderate complexity patterns as selected by Architect. Allow for angles and cutting of tiles.

B. Mortar Adhesive and Grout:
   1. Portland Cement: ASTM C150, Type 1
   2. Lime: ASTM C206, Type "S"
   3. Sand: ASTM C144
   4. Water: Potable

5. Bond Coat: Dry-set mortar conforming to ANSI A118.4
6. Organic adhesive: Comply with ANSI A136.1. Furnish current Certification of Conformance.
7. Grout (Typical except at wet areas and restroom floors):
   a. As instructed by tile manufacturer.
   b. Color selected by Architect.

C. Epoxy Grout (At wet areas and restroom floors): Use one (1) of the following 100 percent solids epoxy grout in accordance with ANSI A118.3. No substitutions. Color shall be as selected by Architect from manufacturer's full line of available colors:
1. Polyblend® Tile Grout with 100 percent Solids Epoxy manufactured by Custom Building Products.
2. LATICRETE® SpectraLOCK PRO Stainless Grout.
3. MAPEI Corp., Kerapoxy or Kerapoxy CQ Epoxy Grout.

D. Crack Isolation Membrane: Provide shower pan waterproofing in accordance with Section 07 13 00.

2.3 THRESHOLDS

A. White Italian Marble thresholds shall be 1/2 inch thick by 2 inches wide by required length, with double 1/4 inch bevel.

2.4 EXPANSION JOINTS

A. Expansion Joint Filler: Flexible and compressible, closed-cell type, rounded at surface to contact sealant as instructed by sealant manufacturer to suit intended use.

B. Silicone compound sealant over filler. ASTM C920, Uses M and A, single component, mildew resistant. Sanded to match grout. Provide at all wall corners, ceilings, control joints and changes in materials, where floor tile abuts perimeter walls, curbs, columns, and pipes; and 24 feet to 36 feet elsewhere.

2.5 MISCELLANEOUS MATERIALS

A. Cement-based Floor Leveling Material: ARDEX K-15 Self-Leveling Underlayment Concrete manufactured by Ardex Engineered Cements, Aliquippa, PA; CX Self-Leveling Underlayment manufactured by BASF Chemrex Inc.; or Ultraplan 1 Plus manufactured by MAPEI Corp., or equal. Gypsum-based products are prohibited.

B. Transition Strips: Of type and size recommended to suit application. Color shall be as selected by Architect from manufacturer's standard colors.

2.6 EXTRA TILE

A. Deliver one (1) unopened box of each type and color of wall and floor tile to the Owner in accordance with Section 01 77 00, Closeout Procedures.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examination: Examine substrates for expansion joints and defects which may affect the work. Do not start work until defects have been corrected. Ensure that surfaces are:
1. Dry, clean, free of oily or waxy films, free of curing compounds.
2. Firm and level within specified tolerances.

3. Minimum of 40 degrees and rising.

B. Tile contractor shall examine preparatory work by others and notify Architect of any imperfections which would affect a satisfactory completion of this tile work. Verify that slab is free of cracks, waxy or oily films, and is well cured. Absence of such notification shall constitute acceptance of responsibility by tile contractor.

3.2 INSTALLATION

A. Align joints (no staggering)

B. Set interior floor tile and grout in accordance with TCA F113 and shower floor in accordance with TCA B415. Set marble thresholds in accordance with TCA TR611 and manufacturer's instructions.

C. Set interior wall tile and grout in accordance with TCA W244 on tile backer cement board at wet areas, showers, and restrooms, TCA W243 on tile backer gypsum board at dry areas not exposed to water or moisture, and TCA W202 on concrete masonry unit (CMU) substrates.

D. Allow minimum of 24 hours after tile is set before grouting.

E. Lay out tile so that the minimum size tile used is 1/2 size.

F. Form internal angles square.

G. Install expansion joints in accordance with TCA publication EJ171.

H. Slope tile within three (3) foot diameter of a floor drain, unless otherwise noted.

I. Damp cure grout in accordance with manufacturer's recommendations.

3.3 CLEANING AND PROTECTION

A. Clean work at completion of installation, remove excess grout from tile surfaces. Clean tile and grout surfaces prior to installation of plumbing fixtures.

B. Wipe all tile with a clean damp cloth, and buff lightly, leaving tile surfaces clean and ready to use.

C. Remove grout from adjacent finish surfaces.

D. Protect finished installation until final acceptance.

END OF SECTION 09 30 13

SECTION 09 51 00 - ACOUSTICAL CEILING PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Acoustical panels.
   2. Concealed and exposed suspension systems for ceilings.
   3. Accessories necessary for a complete installation.

1.3 SUBMITTALS

A. Product Data: Technical data for each product including installation instructions.

B. Samples:
   1. Acoustic Panel: Set of 6 inch (150 mm) square samples of each type, color, pattern, and texture.
   2. Exposed Suspension System Members, Moldings, and Trim: Set of 12 inch (300 mm) long samples of each type, finish, and color.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Suspended ceiling components.
   2. Structural members to which suspension systems will be attached.
   3. Size and location of initial access modules for acoustical panels.
   4. Items penetrating finished ceiling including but not limited to the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Access panels.

   5. Perimeter moldings.

D. Maintenance Data: Manufacturer data for finishes for inclusion in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Building Code: Comply with applicable requirements of the IBC for interior finishes.
   2. Acoustical Panel Standard: ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance.
      a. Mounting Method for Measuring NRC: Plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface according to ASTM E 795.

   3. Surface Burning Characteristics: Ceiling panels with surface burning characteristics complying with IBC Chapter 8 and ASTM E 1264 for Class A materials determined by testing identical products in accordance with ASTM E 84:
      a. Flame Spread Index : 25 or less

b. Smoke Developed Index: 450 or less.

4. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
5. Fire Resistance Ratings: Comply with ASTM E 119; testing by qualified testing agency. Identify products with appropriate markings of applicable testing agency. Indicate design designations from UL *Fire Resistance Directory* or from the listings of another qualified testing agency.

B. Source Limitations:
1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
2. Suspension System: Obtain each type through one source from a single manufacturer.

C. Stone Wool Substrate- inherently antimicrobial and mold, mildew, and sag resistant.
1. Coating Based Antimicrobial Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment; and showing no mold or mildew growth when tested in accordance with ASTM D3273.
2. Panel Based Antimicrobial Treatment: Provide acoustical panels manufactured with antimicrobial treatment in the panels.

D. Preinstallation Conference: Conduct conference at site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to site in original, unopened packages and store in a fully enclosed, conditioned space protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes. Stone Wool Panels- Moisture and humidity will not affect panels.

B. Before installing acoustical panels, allow panels to attain room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation. Stone Wool panels do not have these environmental conditions.

1.7 WARRANTY

A. Standard Ceiling Panels: Warrant ceiling panels to be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects for a period of one (1) year from the date of Substantial Completion.

B. Sag Resistant Ceiling Panels: Thirty (30) year Warranty to warrant products to be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects for a period of ten (30) years from the date of Substantial Completion.

C. Standard Suspension System: Suspension systems shall be warranted to be free from defects in material or factory workmanship and shall not incur 50 percent red rust as defined by ASTM B117 test procedures for a period of forty (40) years from the date of Substantial Completion.

D. Suspension system / ceiling panels: Provide manufacturers standard forty (40) year warranty for suspension systems when used in combination with same manufacturers sag resistant ceiling panels. Ceiling panels to be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects. Suspension systems shall not incur 50 percent red rust as defined by ASTM b117 test during the period of the warranty, extra materials.

1.8 EXTRA STOCK

A. Furnish extra materials matching products installed and packaged with protective covering for storage and identified with labels describing contents.
   1. Acoustical Ceiling Panels: Full size panels equal to 2 percent of quantity installed.
   2. Suspension System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
   3. Hold Down Clips: Equal to 2 percent of quantity installed.
   4. Impact Clips: Equal to 2 percent of quantity installed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturer: Subject to compliance with requirements, provide ceiling panels and grid systems by one of the following:
   1. Concealed and Exposed Suspension Grid:
      a. Armstrong World Industries, Inc.
      b. CertainTeed Corporation.
      c. Chicago Metallic; Rockfon (Roxul Inc.).
      d. Hunter Douglas.
      e. USG Interiors.

   2. Acoustic Ceiling Panel:
      a. Armstrong World Industries, Inc.
      b. CertainTeed Corporation.
      c. Rockfon.
      d. Tectum Inc.
      e. USG Interiors.

   3. Molding and Edge Trim:
      a. Armstrong World Industries, Inc.
      b. CertainTeed Corp.
      c. Chicago Metallic Corporation.
      d. Fry Reglet Corporation.
      e. Gordon, Inc.
      f. USG Interiors, Inc.; Subsidiary of USG Corporation.

   4. Acoustical Sealant for Exposed and Concealed Joints:
      a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
      b. USG Corporation; SHEETROCK Acoustical Sealant.

   5. Acoustical Sealant for Concealed Joints:
      a. Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.
      b. Pecora Corporation; AIS-919.

B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
   1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.2 METAL SUSPENSION SYSTEM

A. Metal Suspension System: Direct hung metal suspension systems of types, structural classifications, and finishes indicated complying with applicable requirements in ASTM C 635/C 635M.
   1. High Humidity Finish: Comply with ASTM C 635/C 635M requirements for *Coating Classification for Severe Environment Performance* where high humidity finishes are indicated.
   2. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1 *Direct Hung*, unless otherwise indicated. Comply with seismic design requirements.
      a. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
         1) Type: Cast in place, postinstalled expansion or postinstalled bonded anchors.
         2) Corrosion Protection: Carbon steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
         3) Corrosion Protection: Stainless steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
         4) Corrosion Protection: Components fabricated from nickel copper alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.

      b. Power Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.

   3. Wire Hangers, Braces, and Ties:
      a. Zinc Coated, Carbon Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
      b. Stainless Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
      c. Nickel Copper Alloy Wire: ASTM B 164, nickel copper alloy UNS No. N04400.
      d. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1 Direct Hung) will be less than yield stress of wire, but provide not less than 0.106 inch (2.69 mm) diameter wire.

   4. Hanger Rods and Flat Hangers: Mild steel, zinc coated or protected with rust inhibitive paint.
   5. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04 inch (1 mm) thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16 inch (8 mm) diameter bolts.
   6. Hold Down Clips: Provide hold down clips spaced 24 inches (610 mm) o.c. on all cross tees in areas with exterior opening larger than 48” x 96”.

7. Impact Clips: Provide impact clip system designed to absorb impact forces against acoustical panels in Gymnasiums.
8. Aluminum cap for use over steel grid in kitchen areas or where shown on drawings or required.

B. Metal Suspension Systems:
1. Wide Face, Steel Capped, Double Web, Fire Rated, Steel Suspension System: Main and cross runners roll formed from cold rolled steel sheet; prepainted, electrolytically zinc coated, or hot dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished 15/16 inch (24 mm) wide metal caps on flanges.
   a. Structural Classification: Heavy duty system.
   b. Face Design: Flat, flush.
   c. Cap Finish: Color selected by Architect.

2. Narrow Face, Steel Capped, Double Web, Fire Rated Steel Suspension System: Main and cross runners roll formed from cold rolled steel sheet; prepainted, electrolytically zinc coated, or hot dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished, cold rolled, 9/16 inch (15 mm) wide metal caps on flanges.
   a. Structural Classification: Intermediate-duty system.
   b. Face Design: Flat, flush.
   c. Cap Finish: Color selected by Architect.

2.3 ACOUSTICAL PANELS

A. Acoustic Panel Type **1**:
1. Basis of Design Product: Artic #600 as manufactured by Rockfon.
2. Classification: Provide fire resistance rated panels complying with ASTM E 1264 for type, form, and pattern:
   a. Type and Form: Type XX, stone wool with painted finish; Form 2, water felted.
   b. Pattern: G (smooth).

3. Color: White.
4. LR: Not less than 0.85.
5. NRC: Not less than 0.75.
6. CAC: Not less than 23.
7. Edge/Joint Detail: Square.
8. Thickness: 5/8 inch.
9. Modular Size: 24 by 24 inches (610 by 610 mm).
10. Stone Wool: Inherently Antimicrobial, inhibiting fungus, mold, mildew and bacteria.
11. Humidity/ Sag Resistance: The resistance of interior coatings to mold and mildew growth is useful in estimating the performance of coatings designed for use in interior environments that promote mold growth and in evaluating compounds that may inhibit such growth and the aggregate levels for their use when tested according to ASTM D 3273.
12. Typical Location: Primary learning areas and classrooms.

2.4 MOLDING, TRIM AND ACCESSORIES

A. Shadow Molding: Where an acoustical lay in ceiling abuts a gypsum board ceiling in the same plane, provide a "W" shaped reveal or "shadow" molding as manufactured by Rockfon.

B. Light Fixture Protection:
1. Manufacturer: Thermafiber Light Fixture Shield Protection Kit by Owens Corning or manufactured by Rockfon.
2. Fire Resistance Rating: Same as ceiling assembly rating.
3. Locations: At fixtures reinstalled in fire rated ceiling assemblies.

C. Roll Formed, Sheet Metal Edge Moldings and Trim: Type and profile for standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color used for exposed flanges of suspension system runners.
   1. Provide edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
   2. For lay in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
   3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

D. Extruded Aluminum Edge Moldings and Trim: Where indicated, provide extruded aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:
   1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 (ASTM B 221M) for Alloy and Temper 6063-T5.
   2. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
   3. Baked Enamel or Powder Coat Finish: Minimum dry film thickness of 1.5 mils (0.04 mm). Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

E. Acoustical Sealant: Comply with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
   1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.
   2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic rubber sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut for compliance with requirements specified that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less than half width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA *Ceiling Systems Handbook*.

1. Fire Rated Assembly: Install fire-rated ceiling systems according to tested fire rated design.

B. Suspend ceiling hangers from building's structural members and as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
   2. Splay hangers where required and, if permitted with fire resistance rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
   4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
   5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
   6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast in place hanger inserts, postinstalled mechanical or adhesive anchors, or power actuated fasteners that extend through forms into concrete.
   7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
   8. Do not attach hangers to steel deck tabs.
   9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
   10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
   11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast in place or postinstalled anchors.

D. Panel Accessibility: Install panels downward accessible by disengaging hinge support rail on one side of panel from the T Bar Flange or optional A Mount rail flange without the use of tools, for access without removal of panel from the ceiling.

E. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
   1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
   2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
   3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

F. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

G. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
   1. Arrange directionally patterned acoustical panels with pattern running in one direction parallel to long axis of space.
   2. For square edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
   3. For reveal edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
   4. For reveal edged panels on suspension system members with box shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
   5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
   6. Install hold-down clips in areas indicated, in areas with exterior opening larger than 48” x 96”, where required by authorities having jurisdiction, and for fire resistance ratings; space as recommended by panel manufacturer's written instructions unless otherwise indicated.
   7. Install clean room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.
   8. Protect lighting fixtures and air ducts to comply with requirements indicated for fire resistance rated assembly.

3.4 FIRE RATING SCHEDULE

A. Refer to UL Assemblies Drawings for Fire Rating requirements of ceiling materials at rated floor and roof assemblies.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
   1. Compliance of seismic design.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.
   1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
      a. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
      b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

D. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 00

SECTION 09 65 13 - RESILIENT BASE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Rubber base.
   2. Accessories necessary for a complete installation.

1.3 SUBMITTALS

A. Product Data: Technical data for each type of product including manufacturer's installation instructions.

B. Samples: Sample of Base Selected or Color Chart if none selected.

C. Maintenance Data: Submit for inclusion in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Entity having minimum 5 years documented experience who employs workers competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store base and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 degrees F (10 degrees C) or more than 85 degrees F (29 degrees C). Store floor tiles on flat surfaces.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 degrees F (21 degrees C) or more than 85 degrees F (29 degrees C), in spaces to receive floor tile during the following time periods:
   1. 48 hours before installation.
   2. During installation.
   3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 degrees F (13 degrees C) or more than 95 degrees F (35 degrees C).

C. Close spaces to traffic for 48 hours after installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Basis of Design Product: Manufacturers and tile series, pattern, and color selections are indicated in the Finish Schedule and are a basis of design. Subject to compliance with requirements, provide product indicated in Finish Schedule or comparable product by one of the following:
   1. Flexco Floors.
   2. Johnsite, a division of Tarkett Group.
   3. Mannington Commercial.
   4. Roppe.

B. Rubber Base: ASTM F1861.
   1. Material: Rubber, vulcanized, Type TS, Group I, Styles A and B.
   2. Manufacturing Method: Group I (solid, homogeneous).
   3. Style: Topset cove; minimum 100 foot coil, cut to length required.
   4. Minimum Thickness: 0.125 inch (3.2 mm).
   5. Color: Selected by Architect.
   6. Height: 4 inches, unless indicated otherwise.
   7. Outside Corners: Job formed.
   8. Inside Corners: Job formed.

C. Adhesives: Water resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for maximum moisture content and other conditions affecting performance of the work.
   1. Verify that finishes of substrates comply with tolerances and other requirements specified for other work and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation after correcting unsatisfactory conditions. Installation of resilient flooring and accessories indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Immediately before installation, sweep clean substrates to be covered by resilient base.

3.3 INSTALLATION

A. Comply with manufacturer's written instructions for installing flooring. Scribe and cut flooring to butt neatly and tightly to vertical surfaces, permanent fixtures, and built in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Extend flooring into toe spaces, door reveals, closets, and similar openings.

B. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on flooring as marked on substrates. Use chalk or other nonpermanent marking device.

C. Resilient Base: Comply with manufacturer's written instructions for installing resilient base. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

1. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
2. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
3. Do not stretch resilient base during installation.
4. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
5. Preformed Corners: Install preformed corners before installing straight pieces.
6. Job Formed Corners:
    a. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
    b. Form without producing discoloration (whitening) at bends.
    c. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
        1) Miter or cope corners to minimize open joints.

END OF SECTION 09 65 13

SECTION 09 65 19 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Static dissipative resilient vinyl composition tile flooring adhesive attached with accessories in locations shown on drawings.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. F150, Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring.
   2. F710, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
   3. F1700, Standard Specification for Solid Vinyl Floor Tile.
   4. F1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

1.3 SUBMITTALS

A. Product Data:
   1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
   2. Manufacturer's installation instructions.

B. Samples:
   1. Actual samples or color charts showing manufacturer's full range of colors for Architect's selection.
   2. 12 inch by 12 inch tile in each color material in each color selected for approval.

C. Certification: Manufacturer's affidavits that materials used in the Project contain no asbestos.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers named first are basis of Specification. Manufacturers listed, whose product meets or exceeds the specifications are approved for use on the Project with Architect's approval. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.2 MATERIALS - ALL MATERIALS MUST BE ASBESTOS FREE

A. Static Dissipative Vinyl Composition Tile:
   1. Quality Standard: ASTM F1700 , Class I, Type A
   2. Electrical Resistance: ASTM F150, 1 by 106 to 1 by 108.
   3. Size: 12 inches by 12 inches by 1/8 inch thick.

4. Patterns and Colors: Moderate complexity patterns as selected by Architect. Allow for angles and cutting of tiles.
5. Approved Products/Manufacturers: “ESD” as manufactured by Flexco; or Architects approved equal by Armstrong World Industries, Inc., Roppe Corp., VPI Floor Products Division.

B. Latex Floor Leveling Material (As required): ARDEX K-15 Self-Leveling Underlayment Concrete or SDF (Feather Finish) Self-Drying, Cement-Based Finishing Underlayment manufactured by ARDEX ENGINEERED CEMENTS Aliquippa, PA; (724) 203-5000. No substitutions

C. Joining and Edge Finish Moldings:
1. Usage: For use at flooring terminations with other flooring.
a. Type: Tapered or bullnose edge, as required to provide juncture at edge of adjacent floor surfaces.
b. Size: One (1) inch wide by 1/8 inch thick or as applicable to the type of flooring and condition.
c. Material: Rubber or vinyl as recommended by flooring manufacturer to suit application.
d. Color(s): As selected by Architect from manufacturer’s available colors.
e. Approved Manufacturers: Burke Flooring, Flexco, Johnsonite, Domco Tarkett, or Architect approved equal.

D. Adhesive:
1. Tile: Solvent-free ESD Epoxy adhesive; same brand as tile or as instructed and approved by tile manufacturer to suit application.

E. Other Materials: Provide other materials, not specifically described but required for a complete and proper installation.

2.3 EXTRA STOCK

A. Deliver to the Owner:
1. Four (4) percent or one (1) unopened carton of each color and pattern of tile selected, whichever is greater.
2. One (1) gallon container of each type adhesive used for flooring.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Prepare concrete floors to receive flooring in accordance with ASTM F710.

B. Verify substrates are smooth, level, at required finish elevation, and without more than 1/8 inch in 10 feet-0 inch variation from level or slopes shown on the drawings.

C. Level substrates by grinding high spots or filling low spots with latex cementitious subfloor filler as required.

D. Broom clean or vacuum the surfaces to be covered, and inspect the substrates.

E. Verify substrates are smooth, level, at required finish elevation, and are ready to receive resilient tile flooring.

F. Bring discrepancies to the attention of the Architect and do not proceed until such discrepancies are corrected.

G. Conduct moisture test in accordance with ASTM F1865 - maximum allowable amount of moisture emission from floor is 3.0 pounds per 1,000 square feet in 24 hour period, and shall not exceed maximum allowable moisture content as allowed by flooring manufacturer.

H. Starting Work indicates acceptance of existing conditions.

3.3 INSTALLATION

A. General:
   1. Install materials only after finishing operations, including painting, have been completed and after permanent heating and cooling system is operating.
   2. Verify that moisture content of concrete slabs, building air temperature, and relative humidity are within the limits recommended by the manufacturers of the materials used.

B. Installing Resilient Tiles:
   1. Place units with adhesive cement in compliance with the manufacturer's recommendations.
      a. Butt units tightly to vertical surfaces, nosings, edgings, and thresholds.
      b. Scribe as necessary around obstructions and to produce neat joints.
      c. Place tiles tightly laid, even, and in straight parallel lines.
      d. Extend units into toe spaces, door reveals, and in closets and similar spaces.

   2. Lay units from center marks established with principal walls, discounting minor offsets, so that units at opposite edges of the room are of equal width.
      a. Adjust as necessary to avoid use of cut widths less than 3 inches wide at edge of space.
      b. Lay units square to axes of the room or space.

   3. Match units for color and pattern by using materials from cartons in the same sequence as manufactured and packaged.
   4. Lay in alternating pattern with grain in all units running 90 degrees from adjacent unit.
   5. Place joining and edge finish moldings, including reducer strips tightly butted to units and secured with adhesive, providing at all unprotected edges unless otherwise shown.

3.4 CLEANING AND PROTECTING

A. Remove excess adhesive and other blemishes from exposed surfaces, using neutral cleaner recommended by the manufacturer of the resilient materials.

END OF SECTION 09 65 19

SECTION 09 90 00 - PAINTINGS AND COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Surface preparation and field painting of exposed items and surfaces.
   2. Field preparation and painting of factory primed metal products and fabrications.
   3. Accessories necessary for a complete installation.

1.3 DEFINITIONS

A. Standard coating terms defined in ASTM D 16 apply.
   1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85 degree meter.
   2. Eggshell refers to low sheen finish with a gloss range between 20 and 35 when measured at a 60 degree meter.
   3. Semigloss refers to medium sheen finish with a gloss range between 35 and 70 when measured at a 60 degree meter.
   4. Full gloss refers to high sheen finish with a gloss range more than 70 when measured at a 60 degree meter.

1.4 SUBMITTALS

A. Product Data: Submit technical data and information for block fillers, primers, paints, and coatings, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
   1. Indicate manufacturer's instructions for special surface preparation procedures, substrate conditions requiring special attention.
   2. Material List: Provide inclusive list of required coating materials. Indicate each material and cross reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number, series, and general classification.

B. Samples: Submit for each type of paint system and in each color and gloss of topcoat.
   1. Provide stepped samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.
   2. Provide list of material and application for each coat of each sample. Label each sample as to location and application.
   3. Submit samples on following substrates for review of color and texture only:
      a. Concrete: Provide two 4 inch square samples for each color and finish.
      b. Concrete Masonry: Provide two 4" x 8" samples of masonry, with mortar joint in the center, for each finish and color.
      c. Painted Wood: Provide two 12 inch square samples of each color and material on hardboard.
      d. Ferrous and Nonferrous Metals: Provide two 4 inch square samples of flat metal and two 8 inch long samples of solid metal for each color and finish.

C. Product List: Submit list of including each paint system, color, and location of application. Use same product and location designations indicated in Finish Schedule.

D. Coating Maintenance Manual: Upon conclusion of the project, the Contractor or paint manufacturer/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams "Custodian Project Color and Product Information" report or equal. Manual shall include an Area Summary with Finish Schedule, Area Detail designating where each product/color/finish was used, product/color/finish was used, product data pages, Manual Safety Data sheets, care and cleaning instructions, touchup procedures, and color samples of each color and finish used.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with Federal and local toxicity and air quality regulations and with Federal requirements on content of for heavy metals including but not limited to: lead and mercury. Do not use solvents in paint products that contribute to air pollution.
   2. Performance and Durability:
      a. ASTM D 16 – "Standard Test Method for Load Testing Refractory Shapes at High Temperatures."
      b. ASTM D 2486 – "Standard Test Method for Scrub Resistance of Interior Wall Paint."
      c. ASTM D 2805 – "Standard Test Method for Hiding Power of Paints by Reflectometry."
      d. ASTM D 4828 – "Standard Test Method for Practical Washability of Organic Coatings."
      e. ASTM D 3363 – "Standard Test Method for Film Hardness by Pencil Test."

B. Applicator Qualifications: A firm or individual having minimum 5 years documented experience in applying paints and coatings similar in material, design, and extent to those indicated.

C. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well ventilated areas with ambient temperatures continuously maintained at not less than 45 degrees F (7 degrees C).
   1. Maintain containers in clean condition, free of foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply waterborne paints when temperatures of surfaces to be painted and surrounding air are between 50 degrees F and 90 degrees F (10 degrees and 32 degrees C).

B. Do not thin or add water to waterbased paints, including waterbased alkyds.

C. Weather Conditions:
   1. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
   2. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 degrees F (3 degrees C) above dew point; or to damp or wet surfaces.
   3. Minimum Application Temperatures for Water based Paints: Between 50 degrees F (10 degrees C) and 90 degrees F (32 degrees C).

D. Apply solvent thinned paints when temperatures of surfaces to be painted and surrounding air are between 45 degrees F. and 95 degrees F (7 degrees F and 35 degrees C).
   1. Minimum Application Temperature for Varnish Finishes: 65 degrees F (18 degrees C) for interior or exterior, unless required otherwise by manufacturer's instructions.
   2. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

E. Provide lighting level of 80 foot candles (860lx) measured midheight at substrate surface.

F. Labels: Do not paint over Underwriters Laboratories, Factory Mutual, other code required labels, or equipment name, identification, performance rating, or nomenclature plates.

1.8 WARRANTY

A. Written warranty signed by the manufacturer and the installer in which the manufacturer and installer agree to repair or replace paint and primers that fail within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Flaking or delamination of paint with the substrate.
      b. Rust, scale, similar imperfections due to improper surface preparation.
      c. Thinning or watering of paint beyond that considered acceptable of paint manufacturer.
      d. Failure to achieve dry film thickness (DFT) recommended by manufacturer for each coat in a paint system.
      e. Deterioration or loss of color of paint beyond normal weathering.

   2. Warranty Period: One year from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Paint: 2 percent, but not less than 1 gallon (3.8 L) of each material and color applied.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Basis of Specifications: Sherwin Williams paints. Subject to compliance with requirements, provide first quality, 100% acrylic, commercial or industrial products of one of the specified manufacturers. Residential products are not permitted.
   1. Proprietary Names: Paint Schedule is based on a single manufacturer for convenience. Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that named products are required to the exclusion of comparable products of specified manufacturers. Furnish product technical data, including per cent solids by weight and volume; VOC content limits and emissions data; and certificates of performance for comparable paint products of specified manufacturer.
   2. Paint Products:
      a. PPG Industries, Inc.
      b. Sherwin-Williams Co.

B. Material Compatibility: Provide each paint system including block fillers, primers, and finish coats, that are compatible with one another and with substrates indicated under conditions of service and application, demonstrated by manufacturer based on testing and field experience.

C. Material Quality: Provide manufacturer's best quality commercial paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint material containers not displaying manufacturer's product identification will not be acceptable. Residential quality paint products are not permitted.

D. Chemical Components of Interior Paints and Coatings: Provide products complying with limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
   2. Restricted Components: Paints and coatings shall not contain components restricted by the EPA.

E. Accessories: Materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

F. Patching Materials: Latex filler compatible with paint systems.

G. Fastener Head Cover Materials: Latex filler.

2.2 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke to engage the services of a qualified testing agency to sample paint materials.
   1. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to site, samples may be taken at the site. Samples will be identified, sealed, and certified by testing agency.
   2. Testing agency will perform tests for compliance with product requirements.
   3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for maximum moisture content and conditions affecting performance of the work.

B. Test substrates after repairing and cleaning substrates but prior to application of paint and coatings.
   1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
      a. Concrete: 12 percent.
      b. Fiber Cement Board: 12 percent.
      c. Masonry (Clay and CMUs): 12 percent.
      d. Wood: 15 percent.
      e. Gypsum Board: 12 percent.
      f. Plaster: 12 percent.

   2. Test cementitious and plaster cement/stucco for alkalinity (pH).

C. Gypsum Board Substrates: Verify joints are taped and finishing compound is sanded smooth.

D. Plaster Substrates: Verify plaster has fully cured. Verify existing plaster is in good condition and can receive new paint coating.

E. Spray Textured Ceiling Substrates: Verify surfaces are dry.

F. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
   1. Verify previously painted surfaces can be stripped to bare substrate, repaired if necessary, and prepared to receive new paint system consisting of primer and two top coats at a minimum.
      a. Note: If previously painted surfaces have failed to accept new paint systems, determine cause of failure and take corrective measures to ensure each surface accepts new paint system. Failure of new paint system is not permitted.

G. Commence paint and coating application after correcting unsatisfactory conditions and surfaces are dry. Application of coating indicates applicator's acceptance of surfaces and conditions.

3.2 ITEMS TO RECEIVE PAINT

A. Generally, all new items that are normally painted in any typical building, including but not limited to the following list:
   1. All ferrous metal
   2. All exterior galvanized metal
   3. All exterior wood
   4. All interior wood
   5. All prime coated hardware
   6. All exposed pipe, plumbing, ductwork, conduit, outlet boxes and electrical cabinets, excluding those located in mechanical rooms.
   7. Aluminum and copper items, unless noted otherwise. (Painting of exposed pipe, including copper, brass, galvanized and black iron pipe and fittings, *is* included.)
   8. All metal grilles, except aluminum, unless otherwise indicated.
   9. All exposed gypsum board surfaces, including all mechanical rooms.
   10. Sealants of types which should not be painted and to which paint will not adhere.
   11. Aluminum, stainless steel, nickel and chrome plated piping and fittings.
   12. Miscellaneous other items which normally require painting or are scheduled to be painted.
   13. Consult plans, finish schedule, details and specifications for other trades as all items usually field painted or finish will be considered as part of the Contract.
   14. All exposed mechanical equipment and electrical equipment.
   15. Traffic lanes and parking spaces including fire lanes and crosswalks.
   16. Rolling doors.
   17. Bollards.
   18. Loose lintels.
   19. Wood Fiber Decks.
   20. Refer to MEP specifications for additional items to receive paint.

B. All work where a coat of material has been applied must be inspected and approved by Architect before application of succeeding specified coat, otherwise no credit for coat applied will be given. Notify Architect when a particular coat has been completed for inspection and approval. Apply coats of material in strict accordance with manufacturer's specifications except where requirements of these specifications are in excess of manufacturer's requirements. Paint all sight exposed pipe and plumbing only after all mechanical work and tests have been completed.

3.3 PREPARATION

A. Coordination of Work: Review work in which primers are provided to ensure compatibility of the total system for various substrates. Notify Architect of anticipated problems when using materials specified over substrates primed by others.
   1. Preprimed Substrates: Inspect existing conditions in which primers are factory applied to ensure compatibility of the total system for each substrate. Notify Architect of anticipated problems when using the materials specified over factory primed or preprimed substrates.
   2. Existing Painted Surfaces: Inspect previously painted surfaces to ensure compatibility of the existing paints with new paint system for each substrate. Notify Architect of anticipated problems.
   3. Correct defects and clean surfaces affecting bond with paint system. Remove existing paints exhibiting loose surface defects showing signs of rust, scale, or delamination.
   4. Seal marks which may bleed through surface finishes.

B. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified. Provide barrier coats over incompatible primers or remove and reprime. If removal is impractical or impossible because of size or weight of item, provide surface applied protection before surface preparation and painting
   1. Remove hardware and hardware accessories, plates, lighting fixtures, and similar items that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface applied protection before surface preparation and painting. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
   2. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface applied protection if any.
   3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
   4. Clean and prepare surfaces to receive paint according to manufacturer's written instructions for each substrate condition and as specified. Provide barrier coats over incompatible primers, existing paint or coating, or remove and reprime.
   5. Correct defects and clean surfaces affecting bond with paint or coating system. Remove existing coatings exhibiting loose surface defects. Seal marks which may bleed through surface finishes.

C. Cleaning: Before applying paint or surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning. Schedule cleaning and painting so dust and contaminants from the cleaning process will not fall on wet, newly painted surfaces.
   1. Remove incompatible primers, including factory applied primers, and reprime substrate with compatible primers or apply barrier coat as necessary to produce paint systems indicated.
   2. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
   3. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
   4. Galvanized Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
   5. Aluminum Substrates: Remove surface oxidation.

D. Mildew and Mold Removal: Remove mildew and mold by high power washing (pressure range of 1500 to 4000 psi) with solution of trisodium phosphate and bleach. If substrate is too soft for

high power washing, scrub substrate with solution. Rinse with clean water and allow surface to dry.

E. Protective Coverings: Provide protections for duration of the work, including covering furnishings and decorative items. Protect and mask adjacent finishes and components against damage, marking, overpainting, and injury. Clean and repair or replace damage caused by painting.

F. Renovated Surfaces: Clean surface free of loose dirt and dust. Except at gypsum board surfaces, remove existing paint and coatings to bare substrate and prepare substrates to receive new paint system. Test substrate to verify it will bond with primer and receive new paint system without failure. If test fails, clean surface to base substrate and apply barrier coat. Retest to verify surface will accept new paint system.
1. Remove surface film preventing proper adhesion and bond.
2. Wash glossy paint with a solution of sal soda and rinse thoroughly.
3. Remove loose, blistered, and defective paint and varnish; smooth edges with sandpaper.
4. Clean corroded iron and steel surfaces.
5. Repair and blend into portland cement plaster.
6. Prime bare surfaces.
7. Tone varnished surfaces with stain bringing to uniform color.
8. If existing surfaces cannot be put in acceptable condition for finishing by customary cleaning, sanding, and puttying operations, notify Owner and do not proceed until correcting unsatisfactory conditions.

G. Cementitious Substrates: Prepare concrete surfaces to receive paint. Remove efflorescence, chalk, dust, dirt, grease, oils, release agents, mold, mildew, and existing paint. Roughen as necessary to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
1. Use abrasive blast cleaning methods if recommended by paint manufacturer.
2. Do not paint surfaces if moisture content or alkalinity of surfaces exceeds that permitted in manufacturer's written instructions.
    a. Determine alkalinity and moisture content of surfaces by performing appropriate pH testing. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct condition prior to application of paint.
    b. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m).
    c. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation after substrates have obtained percent relative humidity level recommended by paint manufacturer.
    d. Perform additional moisture tests when recommended by manufacturer. Proceed with installation when moisture content complies with that permitted in manufacturer's written instructions.
    e. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water. Allow to thoroughly dry.

3. Clean concrete floors to receive paint or coating with a 5 percent solution of muriatic acid or etching cleaner. Flush floors with clean water to remove acid; neutralize with ammonia, rinse, allow to dry; vacuum before painting.

H. Ferrous Metals: Clean ungalvanized ferrous metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC recommendations.
1. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.

2. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
3. Touch up bare areas and shop-applied prime coats that have been damaged. Wire brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.

I. Galvanized Ferrous Metal Substrates: Clean galvanized surfaces with nonpetroleum based solvents leaving surface free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

J. Shop Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop primed surfaces.

K. Aluminum Substrates: Clean surfaces to remove oil, grease, surface oxidation, and contaminants in accordance with SSPC SP-1 Solvent Cleaning. Lightly abrade surface with a nonmetallic pad.

L. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

M. Plaster/Stucco Substrates: Remove contaminants, release agents, curing compounds, efflorescence, chalk, mold, mildew, and similar deterrents. Spot patch existing plaster to eliminate blisters, buckles, excessive crazing, and to check cracking, dryouts, efflorescence, sweat outs, and similar deflects the prevent plaster from bonding with paint or coatings. Sand or texture repair or patch to match adjacent finish and to remove trowel marks and arrises.
1. Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
2. Deep Cracks: Clean out and fill deep cracks with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
3. Do not paint surfaces if moisture content or alkalinity of surfaces exceeds that permitted in manufacturer's written instructions. Test for alkali using litmus paper.
4. Allow patching and repair compounds to set and cure before painting.

N. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.

O. Wood Substrates:
1. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime, stain, or seal wood to be painted. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
4. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
5. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

P. Pipe Covering and Insulation: Clean to remove loose, foreign, and objectionable material before applying sealing coat.

Q. Preparation of Substrates for Wallcovering: Prime and seal substrate with release coat in accordance with wallcovering manufacturer's recommendations for substrate.
   1. Assure compatibility with product of wall covering manufacturer.
   2. Fill indentations in substrate and prime with opaque white primer before applying release coat.
   3. Apply release coat in accordance with manufacturer's recommendations.

R. Barrier Coat: Provide barrier coats over incompatible primers or remove and reprime. Notify Owner in writing of anticipated problems using specified finish coat material over previously coated substrates.

S. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
   1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
   2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
   3. Do not use thinners for water based paints.
   4. Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.4 APPLICATION

A. Comply with manufacturer’s written instructions and recommendations applicable to substrates and paint systems indicated.
   1. The term *exposed surfaces* includes areas visible when permanent or built in fixtures, grilles, convector covers, covers for finned tube radiation, and similar components are in place. Extend coatings in these areas to maintain system integrity and provide desired protection.
   2. Use applicators and techniques suited for paint and substrate indicated.
   3. Provide finish coats compatible with primers.
   4. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   5. Paint exposed surfaces. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces.
      a. Field painting of exposed surfaces include bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory applied final finish.
      b. Areas visible when permanent or built in fixtures, grilles, convector covers, covers for finned tube radiation, and similar components are in place.
      c. Extend coatings in areas, as required, to maintain system integrity and provide desired protection.
   6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
   7. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
   8. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

9. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
10. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or surface imperfections. Cut in sharp lines and color breaks.
11. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
12. Provide finish coats compatible with primers used.
13. Sand lightly between each succeeding enamel or varnish coat.

B. Items not to Receive Paint: Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

C. Applicators: Apply paints and coatings by brush, roller, spray, or applicators recommended by manufacturer.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool recommended by manufacturer for material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size recommended by manufacturer for material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
1. Measure film thickness on magnetic surfaces by use of Elcometer thickness gauge and on nonmagnetic surfaces by pit gauge or Tooke Gauge.

E. Application: Apply first coat to surfaces that have been cleaned, pretreated, or prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
2. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished after removing rust and scale and priming or touching up surface sand if acceptable to topcoat manufacturers.
3. If undercoats, stains, or conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried and cured to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

F. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
1. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
2. Prime and paint uninsulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, heat exchangers, tanks, ductwork, conduit, switchgear, and paintable insulation except where items are prefinished.
3. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint

dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.

4. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
5. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and numbering.
6. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
7. Concealed Members: Wherever steel and metal parts to receive paint are built into and concealed by construction, paint as specified for exposed parts so finish painting is complete before members are concealed.

G. Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work: Painting is limited to items exposed in equipment rooms and occupied spaces.

1. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
2. Prime and paint uninsulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, heat exchangers, tanks, ductwork, conduit, switchgear, and paintable insulation except where items are prefinished.
3. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
4. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
5. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and numbering.
6. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

H. Electrostatic Spray Painting: Apply coating electrostatically to finished surfaces, free from runs, sags, visible overlaps, holidays, craters, pinholes and other defects detrimental to protective and decorative qualities of coating.

1. Thickness of Coatings: 1.5 to 2.0 mils dry film thickness. Measure dry film thickness with magnetic gauge.
2. Use application techniques, equipment, materials, and preparation procedures recommended by manufacturer.

I. Block Fillers: Apply block fillers to concrete masonry block at rate to ensure complete coverage with pores filled.

J. Prime Coats: Before applying finish coats, apply prime coat, recommended by manufacturer, to material required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or defects due to insufficient sealing.

K. Finish Coats: Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance without bleed through.

1. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or surface imperfections is not acceptable.

2. Transparent (Clear) Finishes: Use multiple coats to produce glass smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections. Provide satin finish for final coats.

L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

M. Touch Up: Touch up marred, scraped, and blemished areas of surfaces which were factory primed or previously coated.
1. Prepare and touch up scratches, abrasions, and blemishes and remove foreign matter before proceeding with succeeding coats.
2. Touch up marred, scraped, and blemished areas of factory primed or previously coated surfaces.
3. Feather touch up coating overlapping minimum 2 inches onto adjacent unblemished areas producing smooth, uniform surface.
4. As soon after erection and installation as possible, touch up fasteners, welded surfaces and surroundings, field connections, and areas on which shop coat has been abraded or damaged with specified primer before corrosion and other damage occurs from exposure.

3.5 FIELD QUALITY CONTROL

A. Dry Film Thickness (DFT) Testing: Tests for dry film thickness may be determined by using a Tooke Scale and microgroover, an electronic scanner, or the Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.6 CLEANING AND PROTECTION

A. It is of the upmost importance to the client that the site remains in a safe, clean, and well maintained condition. At the end of each day, leave the site ready to use by staff and students. Protect staff and students and the learning environment throughout the work.

B. Cleanup: At the end of each day, remove empty cans, rags, rubbish, and discarded paint materials from site. After completion of painting work, clean glass and paint spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. Provide *Wet Paint* signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work. After related work is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

E. At completion of painting activities, touch up and restore damaged or defaced painted surfaces.

F. Waste Management: Legally dispose of unused paint and paint containers in accordance with manufacturer’s recommendations and environmental regulations.

PART 4 - SCHEDULES

A. The following is a schedule of typical painted items and does not specifically include every item that is to receive paint but should establish type and quality of finish for all items normally included in a complete paint job.

B. Exterior Surfaces: Note: Exterior surfaces are divided into two (2) different categories, based upon color and level of graffiti resistance required. System 1 will be used when standard earthtone colors or neutral colors are specified, and System 2 will be used when bright colors (primary reds, yellows, and oranges) are specified and/or when a graffiti resistant coating is required.

1. Galvanized Metal:
   a. Surface Preparation: Acid etch galvanized surfaces that have not weathered at least six (6) months prior to beginning painting operations.
   b. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310)
   c. Finish: Two (2) coats Sher-Cryl HPA High Performance Acrylic (B66W300)

2. Galvanized Metal: Chloramine environment.
   a. Surface Preparation: Acid etch galvanized surfaces that have not weathered at least six (6) months prior to beginning painting operations.
   b. Finish: Two (2) coats Macropoxy 646 (B58-600).

3. Un-galvanized Metal:
   a. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310)
   b. Finish: Two (2) coats Sher-Cryl HPA High Performance Acrylic (B66W300)

3. Un-galvanized Metal: Cooling Towers/High Humidity.
   a. Primer: One (1) coat Pro-Cryl Pro-Industrial Universal Primer (B66W310).
   b. Finish (One Coat): One (1) coat Macropoxy 646 Fast Cure Epoxy (B59W610).
   c. Finish (Two Coat): Hi-Solids Polyurethane (B65-300).

4. Concrete and CMU:
   a. Primer/Finish: (2) coats Loxon XP Exterior Waterproofing System, 14-18 mils wet, 6.4 – 8.3 mils dry per coat

5. Wood (Includes plywood siding and wooden trim):
   a. Primer: One (1) coat A-100 Latex Wood Primer (B42W41)
   b. Finish: Two (2) coats A-100 Acrylic Gloss (A8 ser.)

6. Fiber-Cement Materials:
   a. Primer: One (1) coat Loxon Masonry Primer (A24W300)
   b. Finish: Two (2) coats A-100 Acrylic Gloss (A8 Series)

7. Parking Line and Driveway Paint: Setfast Waterborne Yellow (TM225) (meets Federal Specification (FS) TTP-1952-B)
8. All piping in mechanical rooms shall be painted in their entirety, in the following colors:
   a. Gas lines: Orange
   b. Domestic cold water: White
   c. Domestic hot water: Pink
   d. Heating hot water: Red
   e. Condenser water: Green
   f. Chilled water: Blue

C. Interior Surfaces:

1. Galvanized Metal:
   a. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310)

b. Finish: Two (2) coats Pro Industrial Performance Acrylic – Semi-Gloss.

2. Shop-Primed Ferrous Metals (Use for metal doors and frames and miscellaneous metal items):
   a. Shop coat by others.
   b. One (1) coat over Steel and Aluminum, Pro Industrial Pro-Cryl Universal Primer (B66W610).
   c. Two (2) coats Pro Industrial Acrylic Semi-Gloss, B66 Series.

3. Gypsum Wallboard:
   a. Primer: One (1) coat ProMar 200 Zero VOC Latex Primer (B28W2600).
   b. Finish: Two (2) coats ProMar 200 Zero VOC Latex Eg-Shel (B20W2651 Series).

   Alternate:
   d. Primer: One (1) coat ProMar 200 Zero VOC Latex Primer (B28W2600).
   e. Finish: Microbicidial Paint: Paint Shield (EPA# 64695-1).
      1) Substitutions must meet EPA #64695-1.

4. Primer Concrete and CMU: (Enamel):
   a. One (1) coat ProMar Block Filler (AB25W25).
   b. Finish: Two (2) coats ProMar 200 Zero VOC Latex Semi-Gloss (B31W2651 Series).

5. Wood: (Painted):
   a. Primer: Premium Wall and Wood Primer (B25W8111).
   b. Finish: ProClassic Waterborne Semi-Gloss (B31 Series).

6. Wood: (Stained):
   a. Stain: SherWood BAC Wiping Stain (S64 Series).
   b. Finish (First Coat): Wood Classics Polyurethane Varnish (A67 Series).
   c. Finish (Second Coat): Wood Classics Polyurethane Varnish (A67 Series).

7. Gypsum Wallboard: (Epoxy) – Kitchens, bathrooms, laboratories, etc.
   a. Primer: One (1) coat ProMar 200 Zero VOC Latex Primer (B28W2600).
   b. Finish: Two (2) coats Pro Industrial Waterbased Epoxy, Eg-Shel (B73 Series).
      OR
   c. Finish: Two (2) coats Pro Industrial Pre-Catalyzed, Eg-Shel (K45 Series).
      1) Location: Corridors & Stairwells.

8. CMU: (Epoxy) - Kitchens, bathrooms, laboratories, etc.
   a. Primer: Two (2) coats Heavy Duty Block Filler (B42W46)
   b. Finish: Two (2) coats Pro Industrial Waterbased Epoxy, Eg-Shel (B73 Series).

9. Concrete and CMU: (Enamel)
   a. Primer: One (1) coat ProMar Block Filler (AB25W25)
   b. Finish: Two (2) coats ProGreen 200 Latex Semi-Gloss (B31-600 Series)

10. Pipe and fittings, including but not limited to copper and brass, at kitchen areas (but excluding aluminum, stainless steel, nickel and chrome plated pipe and fittings):
    a. Primer: One (1) coat; product recommended for the substrate by the finish coat manufacturer.
    b. Finish: Two (2) coats bright aluminum paint, S-W BondPlex Aluminum (B71S200).

D. Paint Types: Refer to the Drawings.

END OF SECTION 09 90 00

SECTION 10 11 00 – MARKERBOARD AND TACKBOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Markerboards.
   2. Tackboard.
   3. Tackstrips.
   4. Display Rails.
   5. Accessories necessary for a complete installation.

1.3 DEFINITIONS

A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 SUBMITTALS

A. Product Data: Technical data for each type of product including construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
   1. Include electrical characteristics for motorized units.

B. Shop Drawings: Submit plans, elevations, sections, details, and attachment to other work.
   1. Indicate sizes and layout, method of attachment, accessories, trim, details and finish.
   2. Show locations of panel joints. Show locations of field assembled joints for factory fabricated units too large to ship in one piece.
   3. Show locations and layout of special purpose graphics.
   4. Include sections of typical trim members.
   5. Include wiring diagrams for power and control wiring.

C. Samples: Submit for each type of visual display unit indicated.
   1. Visual Display Panel: Not less than 8-1/2 inches by 11 inches (215 mm by 280 mm), with facing, core, and backing indicated for final work. Include one panel for each type, color, and texture required.
   2. Trim: 6 inch (150 mm) long sections of each trim profile.
   3. Display Rail: 6 inch (150 mm) long section of each type.
   4. Rail Support System: 6 inch (152 mm) long sections.
   5. Accessories: Full size Sample of each type of accessory.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Surface Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame Spread Index: 25 or less.
b. Smoke Developed Index: 450 or less.

2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Accessibility Requirements: Comply with applicable requirements.
   a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
   b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
   c. Texas Accessibility Standards (TAS) 2012.

B. Installer Qualifications: Entity having minimum 5 years documented experience that employs installers and supervisors who are trained and approved by manufacturer.

C. Source Limitations: Obtain each type of visual display unit from single source from single manufacturer.

D. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
1. Build mockup of typical shown on Drawings. Include accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Conduct conference at site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Field Measurements: Verify actual dimensions of construction contiguous with visual display units by field measurements before fabrication.
1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.8 WARRANTY

A. Porcelain Enamel Face Sheets: Written warranty in which Manufacturer agrees to repair or replace porcelain enamel face sheets that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
   a. Surfaces lose original writing and erasing qualities.
   b. Surfaces exhibit crazing, cracking, or flaking.
   c. Noticeable deterioration of finish.

d. Writing surface delamination.
e. Fabric discoloration, tearing, or delamination.
f. Unit releasing from substrate.

2. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Porcelain Enamel Face Sheet: PEI-1002, with face sheet two or three coat process.

B. High Pressure Plastic Laminate: NEMA LD 3.

C. Natural Cork Sheet: Seamless, single layer, compressed fine grain cork sheet; bulletin board quality; face sanded for natural finish with surface burning characteristics indicated.

D. Plastic Impregnated-Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout with surface-burning characteristics indicated.

E. Vinyl Fabric: Mildew resistant, washable, complying with FS CCC-W-408D, Type II, burlap weave; weighing not less than 13 oz./sq. yd. (440 g/sq. m); with surface burning characteristics indicated.

F. Polyester Fabric: Nondirectional weave, 100 percent polyester; weighing not less than 15 oz./sq. yd. (508 g/sq. m); with surface-burning characteristics indicated.

G. Hardboard: ANSI A135.4, tempered.

H. Particleboard: ANSI A208.1, Grade M-1.

I. Medium Density Fiberboard: ANSI A208.2, Grade 130.

J. Fiberboard: ASTM C 208 cellulosic fiber insulating board.

K. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.

L. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063.

M. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.

N. Primer/Sealer: Mildew resistant primer/sealer recommended in writing by visual display unit manufacturer for intended substrate.

2.2 MARKERBOARD AND TACKBOARD

A. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

1. Aarco Products, Inc.
2. ADP Lemco Incorporated, (ALinc).
3. Best Rite Manufacturing.
4. Claridge Products and Equipment, Inc.
5. Marsh Industries, Inc.
6. Platinum Visual Systems.

B. Markerboard: Factory fabricated.
   1. Basis of Design: Claridge LCS^3
   2. Assembly: Indicated on Drawings.
   3. Corners: Square
   4. Width: As indicated on Drawings.
   5. Height: As indicated on Drawings.
   6. Mounting Method: Direct to wall, ensure wood blocking is provided in wall for mounting.

C. Markerboard Panel: 24 gauge porcelain enamel steel LCS 24 face sheet on 7/16 inch MDF core with 0.015 inch aluminum back sheet.
   1. Color: White.
   2. Magnetic.

D. Horizontal Sliding Visual Display Units: Factory fabricated units consisting of extruded aluminum tubular frame, fixed rear visual display panel, aluminum framed horizontal sliding visual display panels, and extruded aluminum fascia that conceals overhead sliding track; designed for recessed mounting. Provide panels that operate smoothly without vibration or chatter.
   1. Two Track Units: Fabricate unit with fixed rear panel covering entire rear surface. Provide two sliding panels, each equal to not less than one/half of overall length of unit.
   2. Three Track Units: Fabricate unit with fixed rear panel covering entire rear surface. Provide three sliding panels, each equal to not less than one/half of overall length of unit.
   3. Four Track Units: Fabricate unit with fixed rear panel centered in and covering not less than one/half of rear surface, and fixed front panel on each side of unit equal to not less than one/quarter of overall length of unit. Provide four sliding panels, each equal to not less than one/quarter of overall length of unit.
      a. Swinging Doors: Fabricated from same construction as sliding panels and supported on full height continuous hinges. Provide visual display panel on both faces of each door.
   4. Hardware: Extruded aluminum overhead track and channel shaped bottom guides; with two nylon ball bearing carriers and two nylon rollers for each sliding panel.
   5. Overall Width: 16 ft.
   6. Overall Height: 4 ft.

E. Tackboard Panel: Vinyl fabric faced panel on core indicated.
   1. Basis of Design: Claridge Fabricork series #1550EW or comparable product.
   2. Fabric Wrapped Edge: Wrap edge of tackboard panel with fabric facing.
   3. Thickness: 1/2 inch (12.7 mm)
   4. Color and Pattern: Selected by Architect.

F. Tackstrips (TS):
   1. 1/4" thick layer of 100% natural cork laminated to 1/4" thick layer of hardboard
   2. Include push pins
   3. Size: 4 feet long by 1-3/4 inches wide
   4. Locations: As shown on drawings or required.

G. Aluminum Frames: Fabricated from not less than 0.062 inch (1.57 mm) thick, extruded aluminum; standard size and shape
   1. Basis of Design: Claridge Series 1 or comparable product

2. Field Applied Trim: Snap on trim with no visible screws or exposed joints.
3. Aluminum Finish: Clear anodic finish.
4. Color and Pattern: Selected by Architect.

H. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board as indicated on approved Shop Drawings.

I. Combination Assemblies: Provide H trim between abutting sections of visual display panels.

J. Chalktray: Continuous.
1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast aluminum end closures.
2. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.

K. Display Rail: Extruded aluminum display rail with plastic impregnated cork insert, end stops, and continuous paper holder, designed to hold accessories.
1. Basis of Design Manufacturer/Product: Claridge 74 EZ Deluxe Map and Display Rail or comparable product.
2. Size: 2 inches (50 mm).
3. Flag Holder: Claridge #76 FH or equal. Two for each room- total, not two per board.
4. Tackboard Insert Color: Selected by Architect.
5. Aluminum Color: Match finish of visual display assembly trim.
6. End Stops: Claridge 75ES or comparable product.

2.3 FINISH REQUIREMENTS

A. Comply with NAAMM *Metal Finishes Manual for Architectural and Metal Products* for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Aluminum Finishes:
1. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
2. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.
3. Baked Enamel or Powder Coat Finish: AAMA 2603, except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the work.

B. Examine roughing in for electrical power systems to verify actual locations of connections before installation of motorized, sliding visual display units.

C. Examine walls and partitions for proper preparation and backing for visual display units.

D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.

E. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation. Clean substrates of substances, such as dirt, mold, and mildew, that impair the performance of and affect the smooth, finished surfaces of visual display boards.

B. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.
   1. Moisture Content: Maximum of 4 percent when tested with an electronic moisture meter.
   2. Prepare substrates indicated to receive glass writing surfaces required by manufacturer's written instructions to achieve a smooth, dry, clean, structurally sound surface that is uniform in color.
      a. Gypsum Board: Prime gypsum board with primer as recommended in writing by primer/sealer manufacturer and glass writing surface manufacturer.
      b. Painted Surfaces: Treat areas susceptible to pigment bleeding.

C. Prime wall surfaces indicated to receive visual display units and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.

D. Prepare recesses for sliding visual display units as required by type and size of unit.

3.3 INSTALLATION

A. Install visual display surfaces in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Install clear silicone caulk along entire top edge of all markerboards and tackboards where they meet the wall.

C. Factory Fabricated Visual Display Board Assemblies: Adhere to wall surfaces with egg size adhesive gobs at 16 inches (400 mm) o.c., horizontally and vertically.
   1. Field Applied Aluminum Trim: Attach trim over edges of visual display boards and conceal clips. Attach trim to boards with fasteners at maximum 24 inches (610 mm) o.c.
   2. Mounting Height: Install visual display units at mounting heights indicated on Drawings, or if not indicated, at heights indicated.
      a. Mounting Height for Grades K through 3: 24 inches (610 mm) above finished floor to top of chalktray.
      b. Mounting Height for Grades 4 through 6: 28 inches (711 mm) above finished floor to top of chalktray.
      c. Mounting Height for Grades 7 and Higher: 36 inches (914 mm) above finished floor to top of chalktray.

3.4 CLEANING AND PROTECTION

A. Clean visual display units according to manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.

B. Touch up factory applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display units after installation and cleaning.

END OF SECTION 10 11 00

SECTION 10 12 00 - DISPLAY CASES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Recessed display/poster case.
   2. Accessories necessary for a complete installation.

1.3 DEFINITIONS

A. Definitions in the AWI, AWMAC, and WI *Architectural Woodwork Standards.*

B. MDF: Medium density fiberboard.

C. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive, and faced both front and back with hardwood veneers.

1.4 SUBMITTALS

A. Product Data: Technical data including material descriptions and finishes, general construction, specific modifications, and installation instructions.

B. Shop Drawings: Submit plans, elevations, sections, details, and attachments to other work. Show fabrication details, dimensions, including types and locations of hardware. Show installation details, including field joints and filler panels. Indicate manufacturer's catalog numbers for casework.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Fire Test Response Characteristics: Where fire retardant materials or products are indicated, provide materials and products with specified fire test response characteristics determined by testing identical products per test method indicated by UL.
      a. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials concealed from view after installation.

   2. Quality Standards:
      a. AWI, AWMAC, and WI Architectural Woodwork Standards.
      b. Comply with ANSI A161.1 testing standards.

B. Manufacturer Qualifications: Manufacturer having minimum 5 years documented experience who is a certified participant in AWI Quality Assurance Program or licensee of WI Certified Compliance Program.

C. Vendor/Installer Qualifications: A vendor having minimum 5 years documented experience who is who is trained and approved by manufacturer for installation of units and a certified participant in AWI Quality Assurance Program or licensee of WI Certified Compliance Program.

D. Source Limitations: Provide manufacturer casework from a single source.

E. Preinstallation Conference: Conduct conference at site.

F. Keying Conference: Conduct conference at site. Incorporate keying conference decisions into final keying requirements.

1.6 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work ensuring that display case can be supported and installed as indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver casework after painting, utility roughing in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store in areas where environmental conditions comply with specified requirements.

B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install display cases until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 degrees F and 90 degrees F (16 degrees C and 32 degrees C) and relative humidity between 43 percent and 70 percent during the remainder of the construction period.
   1. Maintain temperature and relative humidity during the remainder of the construction period in range recommended for location by AWI, AWMAC, and WI *Architectural Woodwork Standards*.

B. Established Dimensions: Where display cases are indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

C. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed, and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Basis of Design: Claridge Products and Equipment, Subject to compliance with requirements, provide basis of design or comparable products of one of the following:
   1. Alinc (ADP Lemco, Incorporated).
   2. Claridge Products & Equipment, Inc.
   3. Poblocki Sign Co.
   4. The Tablet & Ticket Co.

B. Display Cases:
1. Construction: Complete case. No visible fasteners or knock-down cases allowed.
2. Usage: Interior.
3. Housing: Aluminum cabinet fully factory assembled with 3/4 inch AC plywood backing.
4. Mounting: Recessed
5. Dimensions: As shown on drawings.
6. Doors: Two (2) regular sliding doors with “H” bars on top and bottom. Framed glass doors required for cases over 66 inches tall.
7. Lock: Provide manufacturers standard lock keyed alike.
8. Vertical Mullions: None.
9. Horizontal Mullions: None.
10. Glazing: 1/4 inch clear glass, horizontally tempered (no tong marks).
11. Finish: Clear anodized.
12. Lighting Type: High output T-8 fluorescent. Dual voltage 120/277 volt ballast.
13. Lighting Location: Top, removable.
14. Baffles: None.
15. Diffusers: Egg crate.
16. Shelving: 1/4 inch polished clear tempered glass, depth as shown on drawings.
17. Depth of Shelving: As indicated on the drawings
18. Edgework: Front edge polished, others swiped.
19. Standards: Surface mounted (Cee)
20. Brackets: Regular with cam lock lever
21. Legs - None.
22. Trim: 3/4 inch aluminum angle.
23. Background Location: Full flat back, 2 - left side, 3 - right side, 4 - floor, and 5 - top.
24. Background Type: Vinyl over 1/4 inch cork. Color as selected by Architect from manufacturer’s standard colors.

C. Poster Case:
1. Mounting: Recessed.
2. Dimensions: As shown on drawings.
3. Doors: Manufacturers standard
4. Glazing: 1/4 inch clear glass, horizontally tempered (no tong marks).
5. Finish: Clear anodized
6. Trim: style ‘AA’.
7. Backgound Type: Full back to be vinyl over 1/4 inch cork.

2.2 FABRICATION

A. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

B. Shop cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

C. Fabricate display case with particleboard or MDF cores, finished with plastic laminate.
1. Cabinet Ends: Solid 3/4 inch particleboard with manufacturer's low pressure laminate finish on interior side and phenolic backing sheet on concealed side; rabbetted at top bottom and back. Provide plastic laminate for exposed exterior surfaces.
2. Cabinet Backs: Standard 1/4 inch (6 mm) fir plywood with manufacturer's low pressure laminate finish on interior surface and phenolic backing sheet on concealed side where

concealed. Provide 3/4 inch (19 mm) particleboard backs with plastic laminate exterior surface where exposed.

3. Cabinet Bottoms: 3/4 inch (19 mm) particleboard with thermoset (low pressure) finish on interior surface and phenolic backing sheet on concealed side; rabbetted to ends. Finish exposed bottoms of wall cabinets with plastic laminate.
4. Cabinet Tops: 3/4 inch (19 mm) particleboard with thermoset (low pressure) laminate finish on interior surface and phenolic backing sheet on concealed side; rabbetted to ends.
5. Doors and Shelves: Install glass doors and shelves to comply with applicable requirements in Section 088000 and in GANA *Glazing Manual*.
   a. For exposed glass edges, polish and grind smooth.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas for compliance with requirements for installation tolerances, location of framing and reinforcements, and conditions affecting performance of the work. Proceed with installation after correcting unsatisfactory conditions.

3.2 CASEWORK INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Install display case level, plumb, and true. Where casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

C. Set display case straight, level, and plumb. Adjust subtops within 1/16 inch (1.5 mm) of a single plane. Align similar adjoining doors to a tolerance of 1/16 inch (1.5 mm). Bolt adjacent cabinets together with joints flush, tight, and uniform.

D. Fasten display case to adjacent cabinets and to masonry, framing, wood blocking, or reinforcements in walls and partitions to comply with the AWI, AWMAC, and WI *Architectural Woodwork Standards* where indicated on Drawings.

E. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.

F. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work.

G. Adjust casework and hardware to allow doors to operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 CLEANING AND PROTECTION

A. Repair or remove and replace defective work as directed on completion of installation.

B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

C. Protect finished installation from damage until time of Substantial Completion. Repair or replace damaged work.

END OF SECTION 10 12 10

SECTION 10 14 00 - GRAPHICS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Room identification signs.
   2. Exterior dimensional letter signage.
   3. Accessories necessary for a complete installation.

1.3 SUBMITTALS

A. Product Data: Technical data for each type of signage.

B. Signage Shop Drawings: Submit fabrication and installation details and attachments to other Work.
   1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
   2. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

D. Certifications: Submit letter of certification from manufacturer that installer and manufacturer is in compliance and meets specified requirements.

E. Samples:
   1. One (1) 6 inch x 6 inch sample of cast metal plaque material with specified finish.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Building Code/City Code: Comply with building code and local ordinances for exterior signage.
   2. Accessibility Requirements: Comply with applicable requirements.
      a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
      b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
      c. Texas Accessibility Standards (TAS) 2012.

B. Installer Qualifications: Installer has minimum 5 Years documented experience in the manufacture of signage and who employs installers and supervisors trained and approved in installation methods for each type of signage.

C. Thermal Movements: For exterior fabricated channel dimensional characters, allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices and electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.6 WARRANTY

A. Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Deterioration of finishes beyond normal weathering.
      b. Deterioration of embedded graphic image.
      c. Separation or delamination of sheet materials and components.

   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Basis of Design Manufacturer: South Texas Graphics; (713) 467-4499. Other manufacturers shall have a minimum of five (5) years experience manufacturing products meeting or exceeding those specified and shall comply with Division 1 requirements for substitutions in order to be considered.
   1. A.R.K. Ramos Architectural Signage Systems; (405) 235-5505.
   2. InPro Corporation (IPC); (800) 2222-5566.
   3. ProWorx Architectural Signage; (713) 666-3131.
   4. South Texas Graphics; (713) 467-4499.
   5. Stanley Signature Signs; (281) 395-6106.
   6. The Southwell Co.; (210) 223-1831.

B. Aluminum Castings: ASTM B 26/B 26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.

C. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

D. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

E. Acrylic Sheet: ASTM D 4802, category standard with manufacturer for each sign, Type UVF (UV filtering).

F. Plastic Laminate Sheet: NEMA LD 3, general purpose HGS grade, 0.048-inch (1.2-mm) nominal thickness.

G. Vinyl Film: UV resistant vinyl film of nominal thickness indicated, with pressure sensitive, permanent adhesive on back; die cut to form characters or images indicated and suitable for exterior applications.

H. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

I. Accessories:
1. Fasteners and Anchors: As necessary for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
   a. Use concealed fasteners and anchors unless indicated to be exposed.
   b. Exposed Metal Fastener Components: Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.

2. Sign Mounting Fasteners:
   a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.

3. Adhesive: Recommended by sign manufacturer.
4. Two Face Tape: High bond, foam core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.
5. Bituminous Paint: Cold applied asphalt emulsion complying with ASTM D 1187.

2.2 SIGNAGE

A. Room Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
1. Laminated Sheet Sign: Photopolymer face sheet with raised graphics laminated over subsurface graphics to acrylic backing sheet to produce composite sheet.
   a. Color(s): Selected by Architect.
2. Sign Panel Perimeter: Finish edges smooth.
   a. Edge Condition: Beveled.
   b. Corner Condition in Elevation: Square.

3. Frame: Aluminum.
   a. Profile: Square.
   b. Corner Condition in Elevation: Square.
   c. Finish and Color: Painted, matte black color.

4. Mounting: Surface mounted to wall with concealed anchors.
5. Text and Typeface, Panel and Photo Polymer Signs: Accessible raised characters and Braille. Finish raised characters to contrast with background color, and finish Braille to match background color.
   a. Raised Characters: Characters and Grade 2 Braille raised 1/32 inch (0.8 mm) above background, uppercase, san serif, minimum 5/8 inch to maximum 2 inch high (no decorative, italic, bold, oblique, script) with contrasting colors on symbols and text only.
   b. Braille: Domed or rounded shape; below corresponding text.
   c. Pictograms: Field height of minimum 6 inches; no characters or braille in pictogram field; nonglare, field contrast to pictogram, text descriptors below pictogram field
   d. Accessibility Symbols: Where used, symbols shall comply with International Accessibility Symbols.

B. Cast Characters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles:
1. Character Material: Cast aluminum.
2. Character Height: Indicated on Drawings.
3. Finishes:
   a. Baked Enamel or Powder Coat Finish: Color to match school colors and logo.
   b. Overcoat: Baked on clear coating.

4. Mounting: Concealed studs.

5. Typeface: Selected by Architect.

C. Field Applied, Vinyl Character Sign: Prespaced characters die cut from 3 mil to 3.5 mil (0.076 mm to 0.089 mm) thick, weather resistant vinyl film with release liner on the back and carrier film on the front for on site alignment and application.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allen Markings.
      b. APCO Graphics, Inc.
      c. Mohawk Sign Systems.
      d. Seton Identification Products.

   2. Size: Indicated on Drawings.
   3. Substrate: Indicated on Drawings.

2.3 FABRICATION

A. Provide sign assemblies according to requirements indicated.
   1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
   2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
   3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
   4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
   5. Internally brace signs for stability and for securing fasteners.
   6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing Work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
   7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

B. Brackets: Fabricate brackets, fittings, and hardware for bracket mounted signs to suit sign construction and mounting conditions indicated. Modify brackets as necessary.
   1. Aluminum Brackets: Factory finish brackets with baked enamel or powder coat finish to match sign background color color unless otherwise indicated.

2.4 FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

E. Aluminum Finishes:
   1. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.
   2. Baked Enamel or Powder Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of signage Work. Verify sign support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

B. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. Install signs using mounting methods indicated and according to manufacturer's written instructions.
   1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
   2. Install signs so they do not protrude or obstruct according to the accessibility standard.
   3. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches (75 mm) of sign without encountering protruding objects or standing within swing of door.
      a. Comply with ADAAG for mounting height and location of each sign.

   4. Before installation, verify sign surfaces are clean and free of materials or debris that impair installation.
   5. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:
   1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
      a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
      b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

   2. Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.
   3. Shim Plate Mounting: Provide 1/8 inch (3 mm) thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other direct mounting methods are impractical. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach signs to plate using method specified above.

C. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10 14 00

SECTION 10 21 17- SOLID PHENOLIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Solid Phenolic (SPC) Core toilet partitions, floor mounted, overhead braced.

1.3 SUBMITTALS

A. Shop Drawings: Within four (4) weeks of award of contract, submit:
   1. Complete shop drawings for the Architect's approval, showing all required field measurements, all details and elevations, plans and sections required to indicate all conditions.
   2. Manufacturer's installation instructions.

B. Certification: Provide a certificate of compliance attesting that all materials are in accordance with manufacturer’s specifications.

1.4 FIELD MEASUREMENTS

A. Field verify dimensions prior to submittals and fabrication.

1.5 WARRANTY

A. Furnish twenty-five year limited warranty for panels, doors, and stiles against breakage, corrosion, delamination, and defects in factory workmanship.

B. Furnish one-year guarantee against defects in material and workmanship for stainless steel door hardware and mounting brackets.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Any one (1) of the following manufacturers whose product meets or exceeds the specifications for those specified is approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding those specified for design, size, finish, and fabrication and comply with Division 1 requirements for substitutions in order to be considered.
   1. Accurate Partitions Corporation, Lyons, IL
   2. Ampco Products, Inc., Sanger, TX
   3. Bobrick Washroom Equipment, Inc., North Hollywood, CA
   4. Bradley Corporation, Menomonee Falls, WI
   5. DesignRite Partitions (Spec-Rite Designs), St. Louis, MO
   6. Flush-Metal Partition, Maspeth, NY
   7. General Partitions Mfg. Corp., Erie, PA
   8. Global Steel Products Corp., Deer Park, NY
   9. Knickerbocker Partition Corp., Irving, TX
   10. Metpar Corp., Westbury, NY
   11. Columbia Partitions, a Division of PSiSC, Columbia, SC
   12. Tex-Lam Manufacturing, Inc., Houston, TX

2.2 MATERIALS

A. General: Comply with the Americans with Disabilities Act (ADA) and Texas Accessibility Standards (TAS).

B. Doors: 1/2 inch thick solid phenolic core with high pressure melamine color surface on faces. Edges shall be burnished and slightly rounded. Standard door size, other than “accessible”, is 24 inches, unless indicated otherwise.

C. Panels: 1/2 inch thick solid phenolic core with high pressure color surface on faces. Edges shall be burnished and slightly rounded.

D. Pilasters: Pilaster Shoes and Sleeves (Caps): Stainless steel.
   1. Pilaster shall be attached to the floor by means of an 11 gauge stainless steel footer, with provisions for leveling, attached to two (2) 3/8 inch diameter stainless steel studs set into expansion shields. The floor connections are to be covered by a four (4) inch high stainless steel shoe, #4 finish.
   2. Option Panels: 1/2 inch thick solid phenolic core with high pressure color surface on faces. Edges shall be burnished and slightly rounded.

E. Headrail: heavy duty aluminum extrusions, anodized with anti-grip configuration, and shall be fastened to the pilaster tops.

F. Hardware and Accessories: Heavy duty operating hardware and accessories.
   1. Hinges: 16-gauge continuous piano, self-closing hinge. Continuous piano hinge shall be attached to door and stile by theft resistant, pin-in-head Torx stainless steel machine screws into factory installed, threaded brass inserts. Fasteners secured directly into the core are not acceptable.
   2. Latch and Keeper: Heavy duty surface mounted cast stainless steel latch unit designed to resist damage due to slamming, with combination rubber faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through bolts.
   3. Coat Hook: Heavy duty combination cast stainless steel hook and rubber tipped bumper, sized to prevent in swinging door from hitting compartment mounted accessories. Mount with through bolts.
   4. Door Bumper: Heavy duty rubber tipped cast stainless steel bumper at out swinging doors and entrance screen doors. Mount with through bolts.
   5. Door Pull: Heavy duty cast stainless steel pull at out swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through bolts.

G. Finish: Melamine color surface on material face, edges burnished. All wood grain panels larger than 57-1/4 inches will have horizontal grain.

H. Color: Shall be selected from the manufacturer’s high pressure plastic laminate color chart. The colors available shall be the same as offered for plastic laminate partitions. Core shall be color-thru.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

B. Install all toilet partitions where indicated on the drawings, and as indicated on the shop drawings, anchoring all components firmly in place for long life under hard use and in complete accordance with the manufacturer's recommendations.

C. Provide blocking/anchoring devices to secure to wall. Anchoring devices must be compatible to wall type to ensure adequate strength.

3.2 CLEANING AND ADJUSTING

A. Clean surfaces free of dirt, oil, grease and other contaminants which detract from appearance of partitions.

B. Except for compartments for the handicapped, adjust doors to remain at a uniformly open position when unlocked.

3.3 REPLACEMENT OF DEFECTIVE MATERIALS

A. Defaced, damaged, scratched or marred materials will not be permitted, will be considered defective, and rejected. Rejected materials shall be replaced with new materials at no additional expense to Owner.

END OF SECTION 10 21 17

SECTION 10 26 13 – CORNER GUARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Surface Mounted, Metal Corner Guards.
   2. Accessories necessary for a complete installation.

1.3 SUBMITTALS

A. Product Data:
   1. Manufacturer's specifications and other data needed to prove compliance with specified requirements of each type corner guard specified.
   2. Manufacturer's installation requirements.
   3. Manufacturer's cleaning and maintenance instructions.

B. Shop Drawings: Show locations of each item and installation details. Provide elevations of non-standard conditions.

C. Samples:
   1. Color charts consisting of actual product pieces, demonstrating full range of available colors, for Architect’s color selection.
   2. 12 inch long piece in full size profiles of corner guard in color selected.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      a. Flame Spread Index: 25 or less.
      b. Smoke Developed Index: 450 or less.

   2. Accessibility Requirements: Comply with applicable requirements.
      a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
      b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
      c. Texas Accessibility Standards (TAS) 2012.

B. Source Limitations: Obtain corner guards products from single source from single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store corner guards in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
   1. Maintain room temperature within storage area at not less than 70 degrees F (21 degrees C) during the period plastic materials are stored.
   2. Keep plastic materials out of direct sunlight.

3. Store plastic wall and door protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 degrees F (21 degrees C).
    a. Store corner guard covers in a vertical position.

1.6 WARRANTY

A. Warranty: Written warranty in which the manufacturer agrees to repair or replace components of wall and door protection units that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
    b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum: Continuous 6063-T6 aluminum retainer behind entire height of corner guard, minimum 0.060 inch thick.

B. Fasteners: Aluminum, nonmagnetic stainless steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security type fasteners where exposed to view.

C. Adhesive: Recommended by protection product manufacturer.

2.2 WALL PROTECTION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Construction Specialties, Inc.
2. InPro Corporation (IPC).
3. JL Industries, Inc.
4. Korogard Wall Protection Systems.
5. Nystrom, Inc.

B. Surface Mounted, Metal Corner Guards: Fabricated as one piece from formed or extruded metal with formed edges; with 90 degree or 135 degree turn to match wall condition.
1. Material: Stainless steel sheet, Type 304.
    a. Thickness: Minimum 0.0625 inch (1.6 mm).
    b. Finish: Directional satin, No. 4.

2. Wing Size: Nominal 3-1/2 inches by 3-1/2 inches (90 mm by 90 mm).
3. Corner Radius: 3/4 inch (19 mm).
4. Mounting: Flat head, countersunk screws through factory drilled mounting holes.

2.3 FABRICATION

A. Fabricate corner guards according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.

B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.4 FINISHES

A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of the work.

B. Examine walls to which corner guards will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

C. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing wall and door protection.

B. Prior to installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Installation Quality: Install wall protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.

C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
   1. Provide anchoring devices and suitable locations to withstand imposed loads.
   2. Where splices occur in horizontal runs of more than 20 feet (6.1 m), splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches (305 mm) apart.
   3. Adjust end and top caps as required to ensure tight seams.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia based household cleaning agent.

END OF SECTION 10 26 13

SECTION 10 28 13 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Public use washroom accessories.
   2. Public use shower room accessories.
   3. Private use bathroom accessories.
   4. Underlavatory guards.
   5. Custodial accessories.
   6. Accessories necessary for a complete installation.

1.3 SUBMITTALS

A. Product Data: Technical Data including construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   1. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
   2. Include electrical characteristics.

B. Samples: Full size, for each exposed product and for each finish specified.
   1. Approved full size Samples will be returned and may be used in the Work.

C. Product Schedule: Show types, quantities, sizes, and installation locations by room of each accessory required. Identify locations using room designations indicated.

D. Maintenance Data: Submit for inclusion in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Accessibility Requirements: Comply with applicable requirements.
      a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
      b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
      c. Texas Accessibility Standards (TAS) 2012.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Source Limitations: Obtain products from single source from single manufacturer.

1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

A. Mirrors: Written warranty signed by manufacturer in which manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, visible silver spoilage defects.
   2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers: Toilet accessories schedule is based on Bobrick Washroom Equipment. Subject to compliance with requirements, provide products by one of the following:
   1. AJW Architectural Products.
   2. American Specialties, Inc.
   3. Bobrick Washroom Equipment, Inc.
   4. Bradley Corporation.
   5. Brey-Krause Manufacturing Co.
   6. GAMCO Specialty Accessories; a division of Bobrick.
   7. Tubular Specialties Manufacturing, Inc.

B. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.

C. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

D. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.

E. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot dip zinc coating.

F. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot dip galvanized after fabrication.

G. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear glass mirrors, nominal 6.0 mm thick.

2.2 COMPONENTS

A. Underlavatory Guard: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
   1. Material and Finish: Antimicrobial, molded plastic, white.

2.3 FABRICATION

A. Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of [**six** keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items. Remove temporary labels and protective coatings. Clean and polish exposed surfaces according to manufacturer's written recommendations.

PART 4 - SCHEDULE

4.1 ACCESSORY SCHEDULE

A. TA-1 - Soap Dispensers:
   1. Mounting: Surface.
   2. Model No.: B-2112.
   3. Locations: All lavatories.

B. TA-2 - Mirrors:
   1. Mounting: Surface.
   2. Model No.: B-290.
   3. Size: 24 inches by 36 inches (600 mm by 900 mm), unless shown otherwise.
   4. Location: All lavatories.

C. TA-3 - Toilet Paper Dispensers:
   1. Mounting: Surface.
   2. Model No.: B-265.
   3. Locations: All water closets.

D. TA-4 - Paper Towel Dispensers:
   1. Model No.: B-262.
   2. Locations: All lavatories.

E. TA-5 - Grab Bars: (At Typical Accessible Toilet Stalls)
   1. Size/Finish: 1-1/2 inch diameter satin stainless steel.
   2. Clearance: 1-1/2 inch between rail and wall.
   3. Model No.: B-6806.
   4. Mounting: Attach with concealed mounting kit. Mount parallel to floor.
   5. Location: Accessible water closets and toilet stalls.

F. TA-6 - Sanitary Napkin Dispensers:
   1. Mounting: Surface.
   2. Model No.: B-2706.
   3. Operation: Single coin / Double coin - (25/50 cents).

4. Capacity: 20 Napkins/ 30 Tampons.
5. Locations: Women's toilet room.

G. TA-7 - Sanitary Napkin Disposal:
1. Mounting: Surface.
2. Model No.: B-270.
3. Locations: Women's toilet rooms.

H. TA-8 Mop and Broom Holder:
1. Mounting: Surface.
2. Model No.: B-239 x 34.
3. Capacity: Four hooks, three mop holders.
4. Locations: Mop sink at each custodial rooms.

I. TA-9 - Grab Bars: (At Accessible Shower)
1. Mounting: Surface.
2. Model: B-6861 modified (24 x 16).
3. Locations: Accessible shower stalls.

J. TA-10 - Folding Benches: Adult Height:
1. Mounting: Surface, reversible.
2. Models: B-5181.
3. Locations: Accessible shower stalls.

K. TA-10 - Folding Benches, Child Height (15 inch (375 mm) seat height):
1. Mounting: Surface, reversible.
2. Models: Bradley 9561.
3. Locations: Accessible shower stalls.

L. TA-11 - Clothes Hook:
1. Mounting: Surface.
2. Model No.: B-6717.
3. Locations: All shower locations.
4. Toilet and Shower Partitions: If toilet and shower partitions are utilized, hooks are to be provided by the partition manufacturer(s) as part of their hardware package.

M. TA-12 - Shower Curtains, Rods and Hooks:
1. Rods: B-047 (36 inches or as indicated).
2. Curtains: B-204-2 (42 inches x 72 inches or as required).
3. Hooks: B-204-1.
4. Mounting/Locations: Accessible shower stalls.

N. TA-13 - Electric Hand Dryers:
1. Mounting: Semirecessed, maximum 3-9/16 inch recess.
2. Model No.: B-750, white.
3. Voltage: 120 volt, single phase.
4. Location: Refer to drawings.

O. TA-14 - Paper Towel Dispenser/Trash Receptacle Combination
1. Mounting: Surface.
2. Model No.: B-3949.
3. Locations: Refer to drawings.

P. TA-15 - Grab Bars: (At Additional Accessible Toilet Stalls)

1. Size/Finish: 1-1/2 inch diameter satin stainless steel, lengths as indicated in drawings.
2. Clearance: 1-1/2 inch between rail and wall.
3. Model No.: B-6806.
4. Mounting: Attach with concealed mounting. Mount parallel to floor.
5. Location: Accessible water closets and toilet stalls.

Q. TA-16 - Diaper Changing Stations:
1. Type: Horizontal station to accommodate infants and toddlers.
2. Construction and Features:
   a. FDA approved injection molded polypropylene with steel on steel hinge system. Fabricate to withstand static loads over 400 pounds.
   b. Child protection straps with snap lock fasteners.
   c. Built in diaper bag hooks.
   d. Built in sanitary liner dispensers; 3 ply, biodegradable.
   e. Premium gas spring mechanism.
   f. Molded usage and safety instructions in six languages and Braille.
   g. ADA compatible.
   h. Antifungal to comply with ASTM standards.
3. Color: Selected by Architect.
4. Dimensions: 35 inches long by 22 inches high by 4 inches deep (875 mm by 550 mm by 100 mm).
5. Approved Product/Manufacturer: Koala Bear Kare Baby Changing Stations, Model KB 200, manufactured by Koala Bear Kare.

R. TA-17 - Trash Receptacle
1. Mounting: Recessed
2. Model No.: B3644.
3. Locations: Refer to drawings.

S. TA-18 – NOT USED

T. TA-19 – NOT USED

END OF SECTION 10 28 13

SECTION 10 44 00 - FIRE EXTINGUISHER AND CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Fire extinguisher.
   2. Extinguisher cabinet.
   3. Brackets.
   4. Accessories necessary for a complete installation.

1.3 SUBMITTALS

A. Product Data:
   1. Manufacturer's specifications and technical data to indicate specification compliance.
   2. Manufacturer’s installation instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Specifications are based on the products of named manufacturers. Other listed manufacturers who produce products equivalent to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent to those specified and comply with Division 1 requirements regarding substitutions to be considered.
   1. Larsen's Manufacturing Co.
   2. The Williams Bros. Corporation of America.
   3. J. L. Industries, Inc.
   4. Nystrom, Inc.
   5. Potter-Roemer.

2.2 MATERIALS

A. Fire Extinguisher Cabinets (FEC):
   1. Size: 24 inches x 9-1/2 inches x 6 inches inside tub dimension.
   2. Type: Semi-recessed with 2-1/2 inch return trim rolled edge; ADA compliant.
   3. Tub Construction: 22 gauge min. steel with standard baked acrylic enamel interior finish.
   4. Door and Frame: 18 gauge min. 304 stainless steel door and frame with vertical decal lettering "FIRE EXTINGUISHER" in red color, unless directed otherwise by Architect.
   5. Glazing: clear acrylic “Duo” vertical glazing panel
   6. Hardware: Continuous concealed piano hinge constructed of material which matches door and trim material. Satin finish pull handle with cam cylinder lock with safety pull designed to release upon firm pull on handle (Larsen’s “Larsen-Loc”™, J.L. Industries “Saf-T-Lok”™; or equivalent).
   7. Bracket: Hook type; Larsen’s #546, or equal.
   8. Finish of Exterior: #4 Stainless steel.

9. Fire rating: as occurs, provide fire rated cabinet, for one or two hour rated conditions as indicated or required by specific location. Cabinet shall be tested and approved by Warnock Hersey to ASTM E-814, and shall bear the Warnock Hersey label.

B. Fire Extinguishers (F.E):
   1. Models/Types:
      a. Multipurpose dry chemical with 10 lbs. capacity and UL 4A-80B:C rating conforming to MP10 Series.

   2. Mounting: Provide eye brackets for direct wall mounting to hook and for mounting in Fire Extinguisher cabinets. Refer to drawings for location and quantity.
   3. Provide initial inspection tag for each extinguisher.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fire extinguishers and cabinets in openings in accordance with manufacturer's printed instructions.

B. Install fire extinguishers and cabinets where indicated on the drawings, or if not indicated, in locations required by governing code and as directed by Owner.

END OF SECTION 10 44 00

SECTION 10 51 13 - METAL LOCKERS AND BENCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Welded corridor lockers.
   2. Accessories necessary for a complete installation.

1.3 SUBMITTALS

B. Product Data:
   1. Manufacturer's schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
   2. Manufacturer's installation instructions.

C. Shop Drawings: Indicate size, material, and finish. Show location and installation procedures. Include details of joints, attachments and clearances.

D. Locker/Lock Schedule: Schedule indicating locker number, serial number of the lock installed, key number, or combinations, as applicable, for each locker. Submit schedule in spread sheet format. Submit three hard copies and one electronic file.

E. Sample: Provide half size locker samples to Architect for approval showing all fasteners and door types for locks.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Accessibility Requirements: Comply with applicable requirements.
      a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
      b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
      c. Texas Accessibility Standards (TAS) 2012.

B. Source Limitations: Obtain metal lockers and accessories from single source from single locker manufacturer.
   1. Obtain locks from single lock manufacturer.

C. Preinstallation Conference: Conduct conference at site.

1.5 WARRANTY

A. Warrant the work specified herein against defects in material and workmanship to the original purchaser for the life of the product.

B. Defects shall include, but not be limited to, the following:
   1. Rapid deterioration of finish.

2. Loose or missing parts.
3. Non-functioning components and mechanisms.
4. Rust, delamination, warp, rot or breakage.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASI Storage Solutions, Inc., Memphis, TN (901) 312-6195
2. DeBourgh Manufacturing Co., LaJunta, CO; (800) 328-8829
3. List Industries, Inc. Deerfield Beach, FL; (800) 776-1342
4. Penco Products, Inc., Oaks, PA; (800) 562-1000
5. Republic Storage Systems Co., Inc., Canton, OH; (800) 477-1255

B. Student Locker: All welded construction; double tier:
1. Material: Prime, high grade Class l mild annealed, cold-rolled steel.
2. General Construction: Pre-assembled, welded seams and joints. Bolts, screws or rivets used in the assembly of the locker bodies are not permitted. Welds shall be free of burrs.
3. Body: 16 gauge, flanged.
4. Backs: 18 gauge, one-piece
5. Door Frame: 16 gauge, channels or angles, with continuous door strike. Multiple tiered assemblies shall have intermediate cross frame welded to vertical framing members.
6. Door: 14 gauge formed door constructed of single piece cold rolled steel. Full channel shaped on lock side, formed channel formation on hinge side, right angle shaped on horizontal sides.
7. Ventilation: Six (6) louvers per door, top and bottom, minimum 7 percent ventilation.
8. Hinges: Two (2) inches high minimum, five (5) knuckle, full loop, tight pin. Weld to door and frame. Two (2) per door for lockers 42 inches high or less; three (3) per door for lockers over 42 inches high.
9. Latching: one-piece, pre-lubricated spring steel, completely contained within the lock bar under tension to provide rattle-free operation. Provide three (3) latching points for lockers over 42 inches in height and two (2) latching points on for all tiered lockers 42 inches and under in height.
10. Pre-Locking Device: Lockers shall be equipped with a positive automatic pre-locking device whereby the locker may be locked while the door is open and then closed without unlocking and without damaging the locking mechanism.
11. Handles: Recessed, stainless steel with non-protruding lifting trigger.
12. Number Plates: Aluminum with etched figures at least 3/8 inches high, attached near top of door with two (2) aluminum rivets. Number plates shall be in order as directed by the Architect.
13. Finish: Baked enamel. Colors shall be as selected by Architect from manufacturer's standard colors. Lockers shall be painted inside and outside with the same color.
14. Fasteners/Anchors: Provide fasteners and anchors of type, size and finish as recommended by manufacturer for attaching or anchoring lockers to walls and floor.
15. Free-Standing Lockers: Provide front and end closed bases.
16. Base: Lockers shall rest on bases as detailed on drawings.
17. Locks: Master Lock Built-In Combination Locks with five (5) Master / Control keys and metal dial. Furnish locker/lock schedule as specified in Paragraph 1.2, D above.
18. Top Closures, Closure Strips, and Fillers: Provide where shown, factory fabricated and finished to match lockers, unless noted otherwise.

C. Benches:
1. Bench Material: Shall be laminated hardwood maple.
2. Size: Shall be 9-1/2 inches deep X 1-1/4 inches thick X lengths as shown on Drawings.

3. Finish: Manufacturer's two (2) coat clear acrylic finish.

D. Pedestals:
1. Manufacturer's heavy-duty cast iron pedestal supports not more than 6 feet-0 inches O.C., with provisions for attaching pedestals to bottom of bench and anchoring pedestals to floor.
2. Height: 17-3/4 inches.
3. Finish: Manufacturer's baked enamel finish in selected color by Architect to match lockers, unless noted otherwise.

E. Anchorages: Provide screw fasteners for attaching each pedestal to bottom of bench and two (2) suitable anchors per pedestal for anchoring pedestals to floor.

F. Accessible Student Locker: Accessible lockers with recessed handles, single tier or the lower opening of double tier locker. Locker bottom shall be a minimum of 15 inches off the floor, or an extra shelf placed 15 inches off the floor with bottom or shelf turned down to close resultant opening.

G. Accessible Benches:
1. Bench Material: Shall be laminated hardwood maple.
2. Size: Shall be 24 inches deep x 48 inches long x thickness recommended by manufacturer to suit application.
3. Finish: Manufacturer's two (2) coat clear acrylic finish. Finish shall be slip-resistant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Assemble and install lockers plumb, level, and flush in the locations shown on the drawings in accordance with the manufacturer's instructions. Lockers shall have no sharp metal edges.

B. Install and anchor lockers to the floor and wall as instructed by the manufacturer.

C. Install sloping hoods, metal fillers, end panels and trim to close openings, and accessories where shown on drawings or required to complete installation. Install using concealed fasteners. Provide flush hairline joints against adjacent surfaces.

D. Ensure number plates are installed in order directed by the Architect.

3.2 ADJUST AND CLEAN

A. Adjust doors and latches to operate without binding and positive latching and automatic locking.

B. Touch up marred finishes on lockers with manufacturer's supplied paint.

END OF SECTION 10 51 13

SECTION 10 56 13 - METAL STORAGE SHELVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Four post metal storage shelving.
   2. Accessories necessary for a complete installation.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design metal storage shelving, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Seismic Performance: Metal storage shelving shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 SUBMITTALS

A. Product Data: Technical data for each type of shelving unit and accessory components including recessed tracks. Include rated capacities, installation and construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Submit plans, elevations, sections, and details, including installation details of connectors, lateral bracing, and special bracing.

C. Seismic Qualification Certificates: For metal storage shelving, accessories, and components, from manufacturer.

1.5 COORDINATION

A. Coordinate sizes and locations of blocking and backing required for installation of metal storage shelving attached to wall and ceiling assemblies.

B. Coordinate locations and installation of metal storage shelving that may interfere with ceiling systems including lighting, HVAC, speakers, sprinklers, access panels, electrical switches or outlets, and floor drains.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install metal storage shelving until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for building occupants during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hot Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

B. Cold Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

C. Metallic Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with G60 (Z180) zinc (galvanized) or A60 (ZF180) zinc-iron-alloy (galvannealed) coating.

D. Steel Tubing: ASTM A 513, Type 2.

2.2 STORAGE SHELVING UNITS

A. Four Post Metal Storage Shelving:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AMCO Corporation.
      b. Dixie Shelving Co,
      c. Equipto.
      d. InterMetro Industries Corporation.
      e. Lyon Workspace Products, LLC.
      f. Montel, Inc.
      g. Penco Products, Inc.
      h. Republic Storage Systems Co.
      i. Safco Products.
      j. Tennsco.

   2. Open Four Post Metal Storage Shelving: Comply with MH 28.1; field assembled from factory formed components. Shelves span between supporting corner posts that allow shelf height adjustment over full height of shelving unit. Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.
   3. Load Carrying Capacity per Shelf: Minimum 700 lb (318 kg).
   4. Posts: Fabricated from hot rolled steel; in standard shape; with perforations at 1-1/2 inches (38 mm) o.c. to receive shelf to post connectors.
      a. Unit Configuration: Configure shelving units as individual, freestanding assemblies.
         1) Add On Shelf Posts: Fabricated from hot rolled steel, standard shape; perforated to match main posts.

      b. Post Base: Adjustable steel floor plate, drilled for floor anchors.

   5. Bracing: Standard, single or double diagonal cross bracing.
      a. Location: At unit back and ends necessary for stability, load carrying capacity of shelves, and number of shelves indicated.
      b. Back Panel: One piece fabricated from cold rolled steel sheet; of nominal: 0.024 inch (0.61 mm) steel sheet thickness.

   6. End Panels: Fabricated from cold rolled steel sheet of nominal: 0.024 inch (0.61 mm) steel sheet thickness.
   7. Solid Type Shelves:
      a. Steel Sheet: Nominal thickness minimum 0.048 inch (1.21 mm) or as necessary for load carrying capacity per shelf.
      b. Metallic Coated Steel Sheet: Nominal thickness minimum 0.052 inch (1.32 mm)or as necessary for load carrying capacity per shelf.

c. Fabricate fronts and backs of shelves with vertical edges that are flanged and returned, with edges reinforced with steel bars, angles, or channels.

8. Framed Type Wire Shelves: Metallic coated steel] wire; with shelf frame fabricated from same material and with same finish as posts.
9. Truss Type Wire Shelves: Metallic coated steel wire over wire construction, with downturned wire truss edges.
10. Shelf Quantity: Six shelves per shelving unit in addition to top and bottom shelf.
11. Shelf to Post Connectors: Mechanical fasteners (nuts and bolts).
12. Base: Closed, with base strips fabricated from same material and with same finish as shelving.
13. Overall Unit Width: As indicated in the Drawings.
14. Overall Unit Depth: As indicated in the Drawings.
15. Overall Unit Height: 84 inches (2134 mm).
16. Accessories:
    a. Finished End Panels: Fabricated as perforated full height panels from standard thickness cold rolled steel sheet and with same finish as posts, with trim for a finished appearance along edges abutting posts and top shelf.

17. Steel Finish: Baked enamel or powder coat.
    a. Color and Gloss: Selected by Architect.

2.3 ANCHORS

A. Floor Anchors: Galvanized steel, post installed expansion anchors or power actuated fasteners. Provide number per unit recommended by manufacturer unless additional anchors are indicated in calculations.

B. Wall Anchors: Galvanized steel anchors designed to secure metal storage shelving to adjacent wall. Provide one per shelving unit for each shelving unit adjacent to a wall unless additional anchors are indicated in calculations.

2.4 FABRICATION

A. Fabricate metal storage shelving components to provide field assembled units that are square and rigid, with posts plumb and true and shelves flat and free of dents or distortion. Fabricate connections to form a rigid structure, free of buckling and warping.
1. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
2. Build in straps, plates, brackets, and other reinforcements as needed to support shelf loading.
3. Cut, reinforce, drill, and tap metal fabrications to receive hardware, fasteners, and similar items.

B. Form metal in maximum lengths to minimize joints. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing the work. Form backs of shelving units of up to 48 inches (1219 mm) wide from one piece.

C. Form edges and corners free of sharp edges or rough areas. Fold back and crimp exposed edges of unsupported sheet metal to form a hem on the concealed side; ease edges of metal plate to radius of approximately 1/32 inch (0.8 mm). Shear and punch metals cleanly and accurately. Remove burrs.

D. Weld corners and seams continuously to develop strength, minimize distortion, and maintain the corrosion resistance of base metals. At exposed locations, finish welds and surfaces smooth and blended so surface is smooth after finishing and contour of welded surface matches that of

adjacent surface. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces before finishing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas for compliance with requirements for installation tolerances and other conditions affecting performance of the work. Examine floors for suitable conditions where metal storage shelving will be installed.

B. Examine walls and ceilings to which metal storage shelving will be attached for properly located blocking, grounds, or other solid backing for attachment of support fasteners.

C. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

A. Vacuum and clean finished floor over which metal storage shelving is to be installed.

3.3 INSTALLATION

A. Install metal storage shelving level, plumb, square, rigid, true, and with shelves flat and free of dents or distortion. Make connections to form a rigid structure, free of buckling and warping.
   1. Install exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
   2. Install braces, straps, plates, brackets, and other reinforcements as needed to support shelf loading and as required for stability.
   3. Adjust post base bolt leveler to achieve level and plumb installation.
   4. Anchor shelving units to floor with floor anchors through floor plate. Shim floor plate to achieve level and plumb installation.
   5. Install seismic restraints.
   6. Connect side to side and back to back shelving units together.
   7. Install shelves in each shelving unit at spacing indicated on Drawings.
      a. Four Post Metal Storage Shelving: Install four clips, one at each post, for support of each shelf; with clips fully engaged in post perforations.

3.4 ERECTION TOLERANCES

A. Erect four post metal storage shelving to a maximum tolerance from vertical of 1/2 inch (13 mm) in up to 10 feet (3 m) of height, not exceeding 1 inch (25 mm) for heights taller than 10 feet (3 m).

B. Erect post and beam metal storage shelving to a maximum tolerance from vertical of 1/4 inch (6 mm) in 84 inches (2134 mm) of height.

3.5 ADJUSTING

A. Adjust metal storage shelving so that connectors and other components engage accurately and securely.

B. Adjust and lubricate operable components to operate smoothly and easily, without binding or warping. Check and readjust operating hardware.

C. Touch up marred finishes or replace metal storage shelving that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal storage shelving manufacturer.

D. Replace metal storage shelving components that have been damaged beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 56 13

SECTION 10 73 13 - ALUMINUM CANOPY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to
   1. Fixed canopy.
   2. Accessories necessary for a complete application.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports, including comprehensive engineering analysis by a qualified professional engineer licensed in the State of Texas, using performance requirements and design criteria indicated.

B. System Performance: Provide canopy system that has been designed, produced, fabricated and installed to withstand normal temperature changes as well as live loading, dead loading and wind loading in compliance with building code requirements:
   1. Live Load: 20 psf minimum.
   2. Structural Design for Wind Forces: Comply with ANSI A58.1.
   3. Base Mean Wind Velocity: 120 mph, Exposure Classification C.
   4. Importance Factor: 1.0.
   5. Stability Criteria: Comply with applicable building codes.
   6. Design structural members to meet minimum deflection criteria of L/180.
   7. Design footings for maximum bearing pressure of 1,500 psf.

C. Provide structure capable of sustaining severe icing, hail, hurricane force winds and supporting concentrated load such as being walked upon.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product data, specifications, component performance data and installation instructions.

B. Shop Drawings: Submit detailed drawings, layout of canopy system, bent locations, mechanical joint locations with complete details, connections, jointing and accessories. Include details of tube anchorage.

C. Samples: Color charts showing full range of colors.

D. Delegated Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible in the jurisdiction of the project, for their preparation.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Building Code: International Building Code.
   2. AWS (American Welding Society) standards for structural aluminum welding.

B. Installer Qualification: Firm with not less than 5 years' experience in installation of aluminum sunshades of type, quantity and installation methods similar to work of this section.

C. Source Limitations: Obtain aluminum covered walkway system from single source.

D. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication where possible, to insure proper fitting of work.

E. Allow for adjustments within specified tolerations wherever taking of field measurements before fabrication might delay work.

F. Shop Assembly: Preassemble units in shop to greatest extent possible and disassemble as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

G. Coordination: Coordinate work of this section with work of other sections which interface with sunshade system (building structure, building finishes, etc.).

1.6 CONTRACTOR'S RESPONSIBILITIES

A. As scope and performance documents, the Drawings and Specifications do not necessarily indicate or describe all Work required for the performance and completion of the Work. Contracts will be let on the basis of such documents with the understanding that the Provide the items required for proper completion of the Work without adjustment to price or schedule. Work shall be of sound, quality construction and the Contractor shall be solely responsible for the inclusions of adequate labor and materials to cover the proper and timely fabrication and installation of the aluminum walkway cover indicated, described, or implied.

B. As a performance specification, the criteria for the solution of structurally sound aluminum walkway cover indicated on the Drawings or specified herein are the sole purpose of defining the design intent and performance requirements. The details shown are intended to emphasize the acceptable profiles and performance requirements for this Project. To avoid any misunderstanding or lack of interpretation, the Contractor is hereby advised that the responsibility for the aluminum walkway cover is totally his and that designs and resolutions proposed in the Contractor's shop drawings, structural calculations, and related documentation shall be demonstrated throughout the Work and warranty period specified or required.

C. Design proposal submissions which follow exactly the details indicated on the Drawings for the aluminum walkway cover, will not relieve the Contractor of his responsibility for the design, fabrication, erection, or performance of the Work of this Section.

D. In the event of a controversy over the design, the decision of the Architect will take precedence.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle sunshade system components as recommended by manufacturer. Handle and store in a manner to avoid deforming members and to avoid excessive stresses.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Basis of Design Product: Avadek Walkway Covers: Subject to compliance with requirements, provide canopies by one of the following:
1. Aluminum Technologies, Inc.
2. East Texas Canopy.
3. Mapes Industries, Inc. Lincoln, NE; (800) 228-2391.
4. Peachtree Protective Covers, Inc.
5. Jones Aluminum Inc.
6. Airvent Remodeling & Design Center, Houston, TX
7. American Walkway Covers, LLC, Pompano Beach, FL
8. Dittmer Architectural Aluminum, Winter Springs, FL
9. Perfection Architectural Systems, Inc., Orlando, FL
10. Superior Metal Products Co., Birmingham, AL
11. Texas Aluminum Industries, Inc., Houston, TX

B. Aluminum Extrusion: ASTM B221 alloy 6063 heat treated to T-6 temper.

C. Aluminum Sheet: ASTM B209, minimum 0.032 inch thickness.

D. Finish: Satin anodize 204-R1 meeting Aluminum Association Specification AA-M-10C-22A-21.

E. Structure shall be designed by the manufacturer to withstand walking on top, heavy hail, and winds in the configurations shown on drawings.

F. Fasteners:
1. Deck Screws: Type 18-8 non-magnetic stainless steel sealed with a neoprene "O" ring beneath 5/8 inch (7 mm) outside dimension, conical washer. Rivets are not permitted.
2. Fascia Rivets: Size 3/16 inch by 1/2 inch (4 mm by 13 mm) grip range aluminum rivets with aluminum mandrel.
3. Bolts, Nuts, and Washers: 18-8 non-magnetic stainless steel.
4. Tek Screws: Not permitted.

G. Beam/Deck connection flashing (Bird cover): .080” thick metal flashing at all beams.

H. Provide concealed drainage from deck into columns.

I. Roof Deck: Shall be of size and depth recommended by the manufacturer to suit application, intended use, requirements of building code authorities having jurisdiction.

J. Expansion Joints: Expansion joints shall have no metal to metal contact.

K. Horizontal U-Beams and vertical tube columns shall be sizes recommended by the manufacturer to suit application, intended use, and requirements of building code authorities having jurisdiction, and shall be attached with concealed fasteners.

2.2 FABRICATION

A. Comply with indicated profiles, dimensioned requirements, and structural requirements. Provide minimum 6 inch by 10 inch (150 mm by 250 mm) structural bents. Provide fascia as indicated.

B. Use sections true to details with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture, free from defects impairing strength and durability.

C. Mechanical Joints: Consisting of stainless steel bolts with minimum of 2 bolts per fastening. Install bolts and nuts concealed utilizing 1/2 inch thick by 1-1/2 inch (13 mm by 44 mm) aluminum bolt bars welded to structural members.

D. Detail mechanical joints on shop drawings showing each location.

E. Roof Deck: Extruded aluminum shapes, interlocking self flashing sections. Shop fabricate to lengths and panels widths required for field assembly. Depth of sections to comply with structural requirements. Provide shop induced camber in deck units with spans greater than 16 feet to offset dead load deflections. Use welded dams at non-draining ends of deck.

F. Expansion joints, design structure for thermal expansion and contraction. Provide expansion joints as required.

G. Provide exposed rivets for fastening bottom of fascia to deck to match fascia finish.

H. Apply shop applied dip coat of clear acrylic enamel to each column end terminating in concrete to insulate from electrolytic reaction. Pierce column ends to "key" grout to bent for maximum uplift protection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for supporting members, blocking, inserts, installation tolerances, and other conditions affecting performance of the work.

B. Confirm locations, dimensions and elevations shown on shop drawings prior to fabrication.

C. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. Erection: Set walkway support tube frames onto steel channels projecting from bidding structure; set to required elevations, align, plumb and level; secure tube frame to structural channels. Comply with manufacturer's instructions.

B. Erection: Set roof support frames (bents) into pockets provided in top of footings; set to required elevations, align, plumb and level; and grout in place with 2,000 psi. portland cement grout. Ensure grout fills voids and keys to columns. Fill downspout units with grout to bottom of discharge level. Install aluminum deflectors after grouting. Match to finish and elevation of adjacent sidewalks.

C. Install roof deck sections, accessories, and related flashing in accordance with manufacturer's instructions. Provide roof slope for rain drainage without ponding water. Align and anchor roof deck units to structural support frames.

3.3 FLASHING

A. Flashings: Flashings required between covered walkway system and adjoining structures are not work of this section. Refer to 07 62 00.

3.4 CLEANING AND PROTECTION

A. Damaged Units: Replace roof deck panels and other components of the work that have been damaged or have deteriorated beyond successful minor repair.

B. Cleaning: Remove protective coverings at time in project construction sequence that provide greatest protection of work. Clean finished surfaces to comply with recommendations of manufacturer.

C. Protection: Protect completed work ensuring walkway cover will be without damage or deterioration at time of Substantial Completion.

END OF SECTION 10 73 13

SECTION 11 31 00 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Dishwasher.
   2. Appliance coordination including service connections, supply lines, and power.
   3. Accessories necessary for a complete installation.

1.2 SUBMITTALS

A. Product Data: Technical data including product specifications, installation, and maintenance instructions.

B. Product Certificates: Submit certificate from product manufacturer stating compliance with requirements and intended use of product.

C. Warranties: Submit manufacturer warranty indicated product is warranted in a light commercial application.

D. Operation and Maintenance Data: Submit for each residential appliance to include in operation and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   2. UL and NEMA: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.
   3. Energy Ratings: Provide energy efficient appliances that carry labels indicating energy cost analysis (estimated annual operating costs) and efficiency information.
   4. Accessibility Requirements: Comply with applicable requirements.
      a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
      b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
      c. Texas Accessibility Standards (TAS) 2012.

B. Product Options: Information on Drawings and in Specifications establishes requirements for product's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

C. Source Limitations: Obtain light commercial appliances from single source and each type of light commercial appliance from single manufacturer.

D. Preinstallation Conference: Conduct conference at site.

1.4 WARRANTY

A. Warranties: Written warranty signed by manufacturer in which manufacturer of the specific appliance specified agrees to repair or replace appliances or components that fail in materials or workmanship within specified warranty period.
   1. Provide appliance and equipment rated for light commercial grade or higher. Residential appliances are not acceptable unless manufacturer warrants residential units in a commercial application and only with Architect's approval.

B. Dishwasher: Full warranty, including parts and labor, for on site service on the product.
   1. Warranty Period for Deterioration of Tub and Metal Door Liner: 10 years from date of Substantial Completion.
   2. Warranty Period for Other Components: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 APPLIANCES

(Products listed are examples. The model numbers listed were current as of 1 May 2016. The model numbers change frequently and without notice. Verify model number and features when selecting.)

A. Dishwasher: Complying with AHAM DW-1.
   1. Basis of Design: General Electric Model GDF570SSFSS.
   2. Type: Built in undercounter.
   3. Dimensions:
      a. Width: 24 inches (610 mm).
      b. Depth: 24 inches (610 mm).
      c. Height (Legs Extended): 34-1/2 inches (876 mm).
   4. Capacity:
      a. International Place Settings of China: 16.
      b. Water Consumption for Full Load: 3.2 gal. (12 L) per cycle.
   5. Sound Level: Maximum 48 dB.
   6. Tub and Door Liner: Stainless steel with sealed detergent and automatic rinsing aid dispensers.
   7. Rack System: PVC coated adjustable, sliding dish racks, with removable cutlery basket.
   8. Controls: Touch pad controls with four wash cycles and hot air and heat off drying cycle options.
   9. Features:
      a. Waste food disposer.
      b. Self cleaning food filter system.
      c. Hot water booster heater for 160 degrees F (71 degrees C) wash water with incoming water at 100 degrees F (38 degrees C).
      d. Lock out feature.
      e. Half load option.
      f. Delay wash option.
      g. Digital display panel.
      h. Water softener.
      i. Soil sensing water use control system.
   10. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
   11. Front Panel: Stainless steel.

B. Appliances, Equipment, and Fixtures: Coordinate equipment, fixtures, appliances regardless which party provides or furnishes. Ensure adequate power supply and properly locate plumbing lines and hook ups, water and drain connections and accessories.

C. Accessories: Provide accessories necessary for a working installation.

2.2 FINISHES

A. Comply with NAAMM *Metal Finishes Manual for Architectural and Metal Products* for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Stainless Steel Finish: Provide appliances with standard finish complying with manufacturer's written instructions for surface preparation including ground and polished stainless steel surfaces for uniform, directionally textured finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with requirements for installation tolerances and conditions affecting performance of work. Coordinate installation of equipment, appliances, fixtures, and other items.
   1. Examine roughing in for piping systems and verify actual locations of piping connections before equipment installation.
   2. Examine electrical circuits and rating and verify locations and sufficient ratings for items requiring electrical power.
   3. Examine space to receive items and verify the space is of sufficient size and configuration for items.

B. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions. Install fixtures level and plumb according to roughing in drawings.

B. Power Supply: Coordinate power supply, grounding, outlets, and electrical wiring with locations indicated for appliances and equipment.

C. Built in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.

D. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

E. Appliance Antitip Device: Install at each appliance according to manufacturer's written instructions.

F. Utilities: Refer to plumbing and electrical sections for plumbing and electrical requirements.

G. Connections and Hook ups: Coordinate location of services.
   1. Grounding: Ground equipment in accordance with applicable standards and code requirements.
   2. Wiring: Connect wiring in accordance with manufacturer recommendations.
   3. Provide necessary electrical outlets.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory authorized service representative:
   1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturer written recommendations. Certify compliance with each manufacturer appliance performance parameters.
   2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After installation, start units to confirm proper operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

B. An appliance will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Test each equipment item to verify proper operation. Make necessary adjustments. Replace malfunctioning appliances and components, then retest. Repeat procedure until units operate properly.

3.4 TESTING AND ADJUSTING

A. Test each equipment item to verify proper operation. Make necessary adjustments. Replace malfunctioning appliances and components, then retest. Repeat procedure until units operate properly.

3.5 CLEANING

A. Clean equipment with manufacturers' recommended cleaning methods and materials. After completing installation of equipment and fixtures, inspect exposed finishes and repair damaged finishes. Remove packing materials from site.

3.6 PROTECTION

A. Provide protective covering for installed appliances. Do not allow use of equipment items for temporary facilities.

3.7 DEMONSTRATION

A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION 11 31 00

SECTION 11 53 00 – LABORATORY EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:
1. Bench mounted fume hoods.
2. Radioisotope fume hoods.
3. Fume hood work surface.
4. Fume hood base cabinet.
5. Cupsinks in fume hoods.
6. Water, laboratory gas, and electrical service fittings and fixtures in fume hoods.
7. Face Velocity Monitor for Constant Volume fume hoods.
8. Face Velocity Control System User Interface for Variable Air Volume fume hoods.
9. Accessories and safety signage.
10. Fume hood commissioning.

B. Related Requirements:
1. Section 12 30 00 "Laboratory Casework" for casework, work surfaces, and service fittings and fixtures.
2. Division 23 – Mechanical: Plumbing Piping.
3. Division 23 – Mechanical: Plumbing Fixtures.
4. Division 23 – Mechanical: Exhaust Ducts; connection from fume hood duct collar to building exhaust system.
5. Division 23 – Mechanical: Exhaust Blowers.
6. Division 26 – Electrical: Final hook up of the fume hood to power.

1.3 ALLOWANCES

1.4 PREINSTALLATION MEETINGS

A. Pre-Installation Conference: Conduct conference at project site.

1.5 ACTION SUBMITTALS

A. Product Data: Manufacturer’s catalog data, specification sheets, and product manuals.

B. Shop Drawings:
1. Submit shop drawings for fume hoods showing the following:
a. Plans, elevations, ends, cross-sections, service run spaces, location and type of service fixtures with lines thereto.
b. Details and location of anchorages, fittings, scribes, and filler panels to floors, walls, fume base cabinets, and base.
c. Layout of units with relation to surrounding walls, doors, windows, lighting and air conditioning fixtures, and building components.
d. Connection to hood exhaust system; location of access doors, cutoff valves, and junction boxes.
e. Coordinate shop drawings and other work involved.

f. Indicate in-wall blocking and rough-in requirements for coordination with other trades.
g. Face openings, air volume, and static pressure drop.

C. Samples for Verification: Samples will be reviewed for color, texture, and pattern only.
1. Hood enclosure: 6 x 6 inch, two samples of each color specified.
2. Front panel: 6 x 6 inch, two samples of each color specified.
3. Liner: 6 x 6 inch, two samples of each material and color specified.
4. Operation signage: One actual size sample of each sign.

D. Certificates:
1. Certify compliance with ASHRAE Std 110 for each model provided.
2. Certify that fume hoods meet the performance requirements specified herein.

E. Operation Data: Submit two copies of operating and maintenance instructions for each fume hood, provided in booklet form providing information on adjustment, operation, and maintenance of hoods.

1.6 QUALITY ASSURANCE

A. Source Limitations: Provide all laboratory fume hoods, and accessories through one source from a single manufacturer.

B. Fume Hood Standard: Provide fume hoods complying with the requirements of SEFA 1, “Laboratory Fume Hoods – Recommended Practices”.

C. Provide factory testing of each type of fume hood specified to demonstrate fume hood performance. Provide testing facility, instruments, equipments, and materials needed for tests.

D. Maintain testing facility at manufacturer’s place of business for testing and evaluating laboratory fume hoods under both ideal and adverse conditions, in accordance with ASHRAE Std 110.

E. Make manufacturing facility, testing facility, and quality control procedures available for Owner inspection.

F. Manufacturer Qualifications:
1. Minimum five years of manufacturing fume hoods as a principal product.
2. Ten installations of equal or larger size and requirements.

G. Installer Qualifications:
1. Factory certified by manufacturer.
2. Ten installations of equal or larger size requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver fume hoods, work surfaces, and accessories free of damage.

B. Ship fume hoods disassembled to fit easily through corridors and doorways at the site.

C. Store and handle in a manner to prevent damage to fume hoods, work surfaces, accessories, or adjacent work.

1.8 PROJECT CONDITIONS

A. Coordinate fume hood and service fitting installation with size, location and installation of service utilities.

B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

C. Rooms in which fume hoods are to be installed shall be broom clean.

1.9 WARRANTY

A. Special Project Warranty: Provide special project warranty, signed by Contractor, Installer, and Manufacturer, agreeing to replace, repair, or restore defective materials and workmanship of laboratory fume hoods during warranty period. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the terms and conditions of the Contract Documents.

B. Warrant against defects in materials and workmanship on fume hoods, work surfaces, and accessories; include labor and replacement parts (except lamps).

C. Warranty Period: One year from date of substantial completion or two years from date of purchase, whichever is sooner.

D. Provide a five year warranty to include coverage for delamination of laminated glass and replacement of same.

PART 2 - PRODUCTS

2.1 PRODUCT OUTLINE

A. General Purpose Fume Hood, General Purpose Fume Hood – ADA Compliant, Radioisotope Fume Hood.
   1. Physical Type: Reference Fume Hood Schedule.
   2. Operational Features:
      a. Operational Type: Reference Fume Hood Schedule.
      b. Face Velocity: 100 ft per minute.

   3. Sash:
      a. Sash Type: Reference Fume Hood Schedule.
      b. Sash Stop:
         1) Manual Type.
         2) Location: 18 inches
   4. Size:
      a. Depth: 31-3/4 inch
      b. Width: Reference Fume Hood Schedule

   5. Exterior Material: Painted, 18 gauge cold rolled steel.
   6. Exterior Color: As selected by Architect from manufacturer standard.
   7. Interior Liner: for General Purpose Fume Hood, Polyresin. For Radioisotope Fume Hood, stainless steel.
   8. Work Surface: for General Purpose Fume Hood: Cast Epoxy Resin; for Radioisotope Fume Hood, stainless steel.
   9. Service Fixtures:
      a. Reference Fume Hood Schedule.

10. Face Velocity Monitor for Constant Volume Fume Hoods; Face Velocity Control System User Interface for Variable Air Volume Fume Hoods:
    a. Reference Division 23. Coordinate cutout in fume hood fascia panel with Monitor/Alarm System manufacturer.

B. Provide factory installed pipes and wires for plumbing and electrical services as indicated on Fume Hood Schedule.
1. Pre-piped Configuration: Piped to 6 inches above top of hood.
2. Pre-piped Material:
    a. Water: Copper
    b. Compressed Air: Copper
    c. Natural Gas: Black Iron
    d. Nitrogen: Copper
    e. Specialty Gas: Stainless steel

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Hotpack.
2. Kewaunee Scientific Corp.
3. Labconco Corporation.
4. ThermoFisher Scientific.
5. Substitutions: See Section 01 25 00 “Substitution Procedures.”

2.3 OPERATIONAL FEATURES

1. Open Bypass Fume Hood for Use with Constant Volume (CV) Exhaust System (Reference Fume Hood Schedule): Open Bypass Fume Hood shall incorporate an automatic air bypass feature above sash opening, which open as sash is closed, to limit the increase in face velocity.
2. Face velocity at the sash shall not exceed 120 cfm.

B. Restricted Bypass Fume Hood for Use with Variable Air Volume (VAV) Exhaust System (Reference Fume Hood Schedule):
1. Exhaust air volume varies proportionally to the hood opening to maintain a constant average face velocity when used with a hood face velocity control system.
2. Face velocity control system furnished and installed in accordance with the requirements of Division 23.

2.4 FABRICATION / MATERIAL-BENCH MOUNTED HOODS

A. Enclosure Construction:
1. Exterior Shell Material: Cold-rolled sheet steel; ASTM A 1008, Designation CS; minimum 18 gauge.
2. Fabricate fume hoods in double wall construction, prefinished, cold-rolled steel exterior shell, with an interior liner and baffle of chemical resistant material as noted.
3. Framework: Frame shall be heavy gauge, welded steel members, reinforced, braced and assembled with exterior shell and interior liner to form a rigid, self-supporting enclosure unit.
4. Screw together component parts to allow removal of interior liner, end panels, front end fascia pieces, top fascia and air foil strips, and to allow access to plumbing lines and service fixtures.
5. End Panels:
    a. Double wall construction; not more than 5 inches wide; without projecting corner posts or obstructions to interfere with smooth, even flow of air.

b. The area between double walls shall house and conceal framing, attaching brackets, remote operating service fixture mechanisms, sash counterbalances and vent pipes, if necessary, from base cabinets.
c. Access panel to service fixture mechanisms concealed between walls shall be provided by full overlap design, removeable gasketed (70 durometer polyvinylchloride or equivalent) access panels on the inside liner walls, or through front corner covers.
d. Terminate end panels flush with interior lining.

6. Corner Covers:
   a. Prepunched and plugged to accommodate up to four service fixtures and two electrical boxes on each side.
   b. For Radioisotope fume hoods, 20 gauge stainless steel, prepunched and plugged to accommodate up to four service fixtures and two electrical boxes on each side.
   c. Mount corner covers vertically on each side of hood sash openings to access plumbing lines and valve connections from front of hoods.

7. Face Opening: Splay or radius top and of face opening to provide an aerodynamic airfoil section to ensure smooth, even flow into the hood.

B. Airfoil Vane:
1. Low profile, ergonomically designed to provide obstruction-free access to hood interior.
2. Mounted flush to top front edge of work surface.
3. Airfoil design shall assure a flow of air rearward along work surface at all hood operating face velocities.
4. On all bench mounted and distillation hoods, provide a removable airfoil vane across bottom of face opening. Profile of airfoil shall match profile of side sections.
5. Mount airfoil with minimum 3/4 inch air space between the foil and top front edge of the work surface to direct positive flow of air across the work surface and to prevent backflow. Extend airfoil under sash line so that sash closes on top of foil.
6. Allow for power cord/tube pass-through near each side post.
7. Material and finish: 14 gauge stainless steel; No. 4 satin finish.

C. Plenum Chamber:
1. Provide plenum with adequate volume for hood dimensions, extending full width of hood to equalize incoming air flow.

D. Bypass Grilles:
1. Provide bypass grilles to conceal plenum.
2. Bypass grilles shall be low resistance type, directionally louvered upward, or can function from above with non-directional grill in the Ceiling closure panel.

E. Interior Liners Material:
1. Polyresin for General Purpose Fume Hoods:
   a. Material: Chemical and abrasion resistant, 1/4 inch thick, fiber reinforced thermoset composite material, defined as any of the following:
      1) White modified epoxy resin with fiberglass reinforced sheet.
      2) White polyester with fiberglass reinforced sheet.
      3) White press-molded, heat-converted catalyzed glass polyester sheet.
   b. Fabrication: Chemically welded seams.
2. Stainless Steel for Radioisotope Hoods:
   a. Material for liner, baffle, top panel, and duct collar: Stainless steel, No. 4 satin finish.
      1) Radioisotope hoods: ASTM A 666 Type 304.
      2) Back and end liner panels: 14 gauge.
      3) Baffle and top liner panels: 16 gauge.

b. Fabrication:
   1) Fully welded seams with stainless steel fillers, ground smooth, and blended to specified finish.
   2) Grind exposed edges smooth and slightly rounded, without sharp edges. Integral bottom and trough.
   3) Inside back and end panels: One-piece, wrap-around construction, welded to the work top forming smooth 1/2 inch radius corners. Do not provide access openings at end panels.
   4) Top liner: Spot weld to back and end panels.
   5) Front fascia panel: Punch to accept front loaded service fittings if required.
   6) Interior corners: 1/2 inch radius, welded, seamless appearance.
   7) Reinforcing: Provide angles and plug hats; weld stainless steel hood liner to for a self-supporting assembly.
c. Fasteners: Stainless steel screws.

F. Baffles:
1. Same material as hood liner.
2. Multiple sections with continuous horizontal slot at the worksurface.
3. Baffle position shall be factory-set for optimal airflow characteristic. Field adjustment shall not be required.
4. Each baffle panel shall be easily removable from the interior, without requiring liner disassembly.
5. Configuration: Full width, with adjustable openings at top and bottom to allow adjusted flow of air through hood to compensate for type of gas, apparatus, or heat source used. Baffles shall be removable for cleaning.
6. Adjustment:
   a. Stop: Provide stop at baffle openings to provide a minimum opening of 1 inch.
   b. Flow restriction limits: The baffle design shall be such that it is impossible, by adjustment, to restrict the volume of air exhausted through the fume hood by more than 20 percent.
   c. Adjustment: Control airflow at top or bottom form a single point, with acid resistant plastic or stainless steel knobs mounted on within end panel enclosure and near front of fume hood.
   d. Baffle designs that require insertion of the operator's head or shoulders for adjustment are not acceptable.

7. Accessories:
   a. Fasteners:
      1) Enclosure panel assembly: Stainless steel truss head screws or rivets; not countersunk type.
      2) Hood baffle to cleats: Stainless steel screws.
   b. Removable plug buttons for holes not used for fixtures.

G. Sash:
1. Vertical Rising Sash (Reference Fume Hood Schedule):
   a. Vertical rising 1/4 inch thick laminated safety float glass sash, epoxy-coated steel sash track, single counterbalance weight.

2. Combination Sash (Reference Fume Hood Schedule):
   a. Four horizontal sliding frameless sash panels.
   b. Reduced frame profile vertical rising sash.
   c. Sash counter balance system.
   d. Incorporate mechanism for latching sash in the full-open position for hood set-up.
   e. Equipped with full-width aerodynamically designed handle and sash frame.
   f. Designed to provide clear view of hood interior.

3. Glazing:
   a. Glass: Safety glass composed of two sheets of double-strength "B" quality, clear sheet glass permanently laminated with a sheet of clear plasticized polyvinyl butyral.
      1) Laminated with 0.015 inch thick clear, plasticized, polyvinyl butyral interlayer; comply with ASTM C 1172.
      2) Comply with ASTM C 1048, Condition A, uncoated, Type 1, transparent, clear, flat, Class 1, q5 Glazing B Quality.
      3) Comply with ANSI Z97.1.

4. Sash Tops:
   a. Factory installed, cam style permanent sash stops.
   b. Location: 18 inch above the fume hood work surface.

5. Blank off panel: On bypass to reduce effective opening.
6. Signage: Provide label on fume hood at this point and a sign to read. "Operating conditions 100 fpm - do not work in hood with sash bottom above this mark."
7. Alarm console: The alarm console shall produce an alarm signal if sash stops are overridden.

H. Exhaust:
1. Entry Cones and Exhaust Connection: Hood manufacturer shall supply and install an acoustical duct transition from hood exhaust collar to the size required for building exhaust duct. Verify diameter dimension of exhaust duct size and location with mechanical drawings.
2. Transition to be equivalent material and finish to building exhaust duct and to conform to industrial ventilation standards. On fume hoods where two exhaust points exist, provide transition as required to accept two exhaust points to mate, as described above, with mechanical system.
3. Exhaust Connection Rings for Radioisotope Hoods: ASTM A 666 Type 304 stainless steel.

I. Utility Service Fittings and Fixtures:
1. Reference Fume Hood Schedule and typical fume hood elevations for model and location of Utility service fittings and fixtures.
2. Orient valves to be readily accessible without
3. t exposing operator's breathing zone to fume hood interior.
4. Factory installed for services as indicated on Fume Hood Schedule.
5. Operation: Remote control.
6. Finish: color coded epoxy. See '12350 Laboratory Casework, Laboratory Service Fittings, Indexes Color and Identification Code' for index colors.
7. Fixtures Location: Plumbing service fixtures shall be located maximum 12 inch from the inside of the sash and shall be on a common vertical centerline.
8. Hose Connectors: Injection molded PVDF - Kynar®.
9. Hose Connectors for Radioisotope Fume Hoods: Chrome-plated brass.
10. Hood Service Fittings: 1/4 inch copper tubing, forged brass valves and seats, TFE-coated silicone bronze stem, TFE packing, and injection-molded PVDF 10-serration hose connectors.
    a. Fixture Handles: Anti-snag, round plastic without projections; color-code and label for designated service.

11. Valves: CSA International labeled with brass-lined copper service lines.

J. Lights:
1. Type: Two-tube, rapid-start fluorescent light fixture of longest practicable length.
2. Ballast: Electronic ballast and be suitable for T-8 lamps.
3. Shield: 1/4 inch thick safety glass or 1/8 inch thick tempered glass panel, sealed air tight into hood body with chemical resistant rubber channels.

4. Lamps: Furnished in accordance with requirements of Division 26.
5. Include light switch, controls interface, and all internal wiring to circuit junction boxes located in upper right and/or left front of plenum area.
6. Toggle Switch: Refer to Division 26 for switch installation requirements. Location shall be on top left sash post.
7. Set units so that fluorescent tubes are replaceable from outside hood.
8. Provide only fixtures that carry UL label.
9. Average interior illumination levels of the work area: 80-foot candles minimum.

K. Electrical Services:
1. Electrical Outlets: Prewire fume hoods for a single point connection. Receptacles to be GFIC type.
2. Closure Strips: Metal to match adjoining surfaces. Provide to close openings between fume hood base cabinet and super-structure and adjacent building wall.
3. Holes: Provide holes for passage of piping, conduit, fixtures, and fittings furnished elsewhere.
4. Fasteners: Stainless steel where exposed to fumes in hood.
5. Signs:
   a. Type: Corrosion resistant plate.
   b. Location: Fume hood exterior.
   c. Content: Condensed information covering recommended locations for apparatus and accessories, baffle settings, and use of sash.

6. Lattice Rod Assembly: Solid 1/2 inch aluminum rod lattice and hardware to support interior hood apparatus where indicated on drawings, reference Fume Hood Schedule.

2.5 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Exterior Sheet Steel Surfaces: Properly prepared and coated, electrostatically applied.
1. Hood Exterior: Epoxy coating, dry powder.
2. Hood Front Panel: Same color and finish with hood exterior shell.
3. Color: Architect to select from manufacturers standard colors.

C. Stainless Steel: Finishes as specified.

D. Chemical and Physical Resistance of Finishes: Test finishes for resistance to chemical reagents in accordance with SEFA 8, and meets Level 1 rating - slight change in color or gloss, and with no loss of adhesion and no loss of film protection.
1. Finishes to meet testing requirements:
   a. Exterior fume hood finish.
   b. Liners.
   c. Work surfaces.

2. Moisture Resistance: No visible effect when finish surface exposed to the following:
   a. Tested in accordance with SEFA 8.
   b. Constant Moisture using a 2 inch x 3 inch x 1 inch cellulose sponge, soaked with water, in contact with surface for 100 hours.
3. Cold Crack: No effect when subjected to 10 cycles of temperature change from 20 degrees F for 60 minutes to 125 degrees F for 60 minutes.
4. Adhesion and Flexibility:
   a. Adhesion: Tested in accordance with SEFA 8; ninety or more squares of the test sample shall remain coated after the scratch adhesion test.

b. Flexibility: No peeling or cracking or exposure of metal when metal is bent 180 degrees over a 1/2 inch diameter mandrel.

5. Hardness: Tested in accordance with SEFA 8 for surface hardness equivalent to 4H or 5H pencil.
6. Abrasion resistance: Maximum weight loss of 5.5 mg. per 100 cycle when tested on a Taber Abrasion Tester #E40101 with 1000 gm wheel pressure and Calibrate #CS10 wheel.
7. Humidity resistance: Withstand 1000 hour exposure in saturated humidity at 100 degrees F.
8. Salt spray: Withstand minimum 200 hour salt spray test.

2.6 WORK SURFACE

A. Cast Epoxy Resin Work Surface:
1. Material: Cast epoxy resin.
2. Thickness: 1 inch.
3. Color: Black
4. Fabrication:
   a. 3/8 inch deep dish rim to contain spills.
   b. Front edge: 6 inch wide by 1/2 inch thick raised edge.
   c. Edge at sides and rear: 1/2 inch wide by 1/2 inch thick raised edge.
   d. Edge attachment: Bond to working surface to make a watertight retaining pan.
   e. Provide penetrations in raised edge of fume hood to accept 2 inch o.d.owner-furnished and installed vacuum line from vacuum pump base cabinets beneath fume hoods.
   f. Provide penetrations in raised edge of fume hood to accept exhaust from vacuum pump fume hood base cabinets and acid storage fume hood base cabinets beneath fume hoods. Coordinate with Fume Hood Base Cabinets, 12350 Laboratory Casework.

5. Polyresin Cupsink:
   a. Size: 7 1/2 inch by 4 1/2 inch.
   b. Mount flush with recessed top of work surface.
   c. Coordinate cupsink location so that gooseneck faucet empties directly into cupsink drain.

B. Stainless Steel Work Surface:
1. Material: 14 gauge stainless steel; No. 4 satin finish.
   a. Radioisotope hoods: ASTM A 666 Type 304.

2. Cup sink: ASTM A 666 Type 304 stainless steel; 5 inch diameter with 1-1/2 inch drain.
3. Mount flush with top of recessed work surface.
4. Coordinate cupsink location so that gooseneck faucet empties directly into cupsink drain.
5. Load bearing capacity: Reinforce work surface to support the following loads:
   a. Uniform loading: Minimum 200 lb.
   b. Maximum loading: 1000 lb per fume hood or base cabinet section.

6. Fabrication:
   a. Radioisotope fume hoods: 1/4 inch deep by 6 inch wide safety ledge across the front edge; dished to contain spillage; watertight.
   b. Fully welded seams with stainless steel fillers, ground smooth, and blended to specified finish.
   c. Edge fabrication: Extend top down to 1 inch thick exposed edge unless noted otherwise, and 1 inch return flange under frame.
   d. Work surface and back and end liner panels shall be one piece without seams or joints.

e. Provide a raised marine edge around perimeter of work surface containing sinks. Pitch top surface two-ways to bowl to provide adequate drainage without channeling or grooving.
f. Where stainless steel sinks occur in stainless steel tops, factory assemble sinks and tops into one integral unit with welds ground and polished. Reinforce work surface at sinks and other penetrations.
g. Seams and joints: Fully welded with stainless steel fillers; grind smooth; and blend to specified finish.
h. Reinforcing: Carbon steel channels welded to the underside of the work surface to prevent twisting, oil canning, and buckling.
i. Provide one coat of heavy build mastic sound deadening material on underside of the work surface. Do not apply to exposed surfaces.

2.7 FUME HOOD BASE CABINETS

A. Material
1. Sheet Steel:
a. Mild, cold rolled and leveled unfinished steel.
b. Minimum gauges:
1) 20 gauge: Interior door fronts, filler panels, shelves.
2) 18 gauge: Case tops, ends, bottoms, bases, backs, vertical posts, and uprights.
3) 16 gauge: Top front rails, top rear gussets, intermediate horizontal rails.
4) 14 gauge: Door and case hinge reinforcements and front corner reinforcements.
2. Sound Deadening Material: Inorganic, for sandwich panel fabrication.

B. Design: Flush Front.

C. Color and Finish: Match fume hood.

D. Acid Storage Cabinets:
1. One piece corrosion resistant interior liner, including the backside of doors and shelf surfaces.
2. One-piece corrosion resistant insert tray with 2 inch lip for containment of spills at bottom of cabinet.
3. One shelf with 1 inch lip, adjustable on 1 inch increments.
4. Vented with a minimum 1-1/2 inch I.D. corrosion resistant vent pipe at rear of cabinet terminating inside of fume hood 2 inch above the working surface.
5. Vent pipe shall be close to rear of hood as possible. Seal opening between working surface and pipe with chemical resistant material.
6. Exhaust ports shall have fire screens.
7. Non-metal door catch or strike plate.
8. Front of cabinet labeled with minimum 1 inch high, 1/4 inch stroke red letters: "ACID".

E. Flammable Liquids Storage Cabinets:
1. Identified for flammable and combustible liquids shall be constructed in compliance with UL, OSHA, NFPA Standard No. 30, and UFC Article 79.
2. Self-closing and self-latching doors synchronized so that both doors will always fully close.
3. Bottom of the cabinet liquid tight to a height of 2 inches.
4. Cabinet shall not have vent outlet.
5. Front of cabinet labeled with minimum 1 inch high, 1/4 inch stroke red letters: "FLAMMABLE - KEEP FIRE AWAY".

F. Vacuum Pump Cabinets:
1. Provide louvered door for exhaust airflow.

2. Vented with a minimum 1-1/2 inch I.D. corrosion resistant vent pipe at rear of cabinet terminating inside of fume hood 2 inch above the work surface.
3. Provide 110V Duplex outlet in back of cabinet.
4. Provide ON/OFF switch on face of fume hood base cabinet apron rail, powering 110V duplex in back of vacuum pump base cabinet.
5. Provide penetrate in top of base cabinet to accept 2 inch o.d.owner-furnished and installed vacuum line from vacuum pump base cabinets beneath fume hoods.
6. Attach toe kick to door. Provide base cabinet without bottom - vacuum pump to rest on finished floor.
7. Provide 110V Duplex outlet on face of fume hood base cabinet apron rail where noted on Fume Hood Schedule.

2.8 FACE VELOCITY MONITOR FOR CONSTANT VOLUME FUME HOODS

A. Operation, Face Velocity Monitor:
1. Face velocity monitor furnished and installed in accordance with the requirements of Division 15.
2. Power requirements: 120 volt AC; prewired to the fume hood.
3. Coordinate cutout in fume hood fascia panel with manufacturer of face velocity monitor.

B. Components, Face Velocity Monitor
1. Alarms:
   a. Digital Display: Liquid crystal display indicating current status.
   b. Audible Alarm Indicator: Minimum intensity of 80 decibels at 4 inch.
   c. Visual Alarm Indicator: Green LED light for normal condition, Red LED warning light for low flow and high flow.
   d. Audible alarm and red warning light shall operate simultaneously to indicate an unsafe operating condition.

C. System Adjustment: Calibrate and adjust the Face Velocity Monitor after the building air handling system has been balanced.

D. Console Mounting: Mount the Face Velocity Monitor on the front of the fume hood as shown on drawings, facing front of hood.

E. Notification Plate: Mount plate on the front of the fume hood housing, adjacent to Face Velocity Monitor. Notification shall read as follows:
1. Alarm will activate when unsafe exhaust condition exists. Red lamp and audible alarm will activate. SHUT DOWN EXPERIMENT AS RAPIDLY AS POSSIBLE. Close sash. Report condition to Safety Office personnel.

F. Signage:
1. Lettering: Manufacturer's standard lettering, background colors, and mounting.
2. Signage Messages: In accordance with requirements of NFPA 45.

2.9 FACE VELOCITY CONTROL SYSTEM USER INTERFACE FOR VARIABLE AIR VOLUME FUME HOODS

A. Operation, Face Velocity Control System User Interface:
1. Face velocity control system and face velocity control system user interface furnished and installed in accordance with the requirements of Division 15.
2. Coordinate cutout in fume hood fascia panel with manufacturer of face velocity control system user interface.
3. Measure and record fume face velocity.

4. Signals unsafe operating conditions whenever fume hood exhaust volumes fall below 80% of that specified for the fume hood or as indicated. Set to activate alarm whenever face velocity deviates from the following:
   a. Sash in position for operating condition: Less than 80 ft/min; greater than 120 ft/min.

5. Remote alarm relay output capability.
6. Alarm delay capability.
7. Power requirements: 120 volt AC; prewired to the fume hood.

B. Components, Face Velocity Control System User Interface:
   1. Alarms:
      a. Digital Display: Liquid crystal display indicating current status.
      b. Audible Alarm Indicator: Minimum intensity of 80 decibels at 4 inch.
      c. Visual Alarm Indicator: Green LED light for normal condition, Red LED warning light for low flow and high flow.
      d. Audible alarm and red warning light shall operate simultaneously to indicate an unsafe operating condition.

   2. Silencer switch: When the silencer switch is activated, the red warning light shall remain “ON” until the unsafe condition is corrected and the alarm unit is manually reset.

C. System Adjustment: Calibrate and adjust the Face Velocity Control System User Interface after the building air handling system has been balanced.

D. Console Mounting: Mount the Face Velocity Control System User Interface on the front of the fume hood as shown on drawings, facing front of hood.

E. Notification Plate: Mount plate on the front of the fume hood housing, adjacent to Face Velocity Control System User Interface. Notification shall read as follows:
   1. Alarm will activate when unsafe exhaust condition exists. Red lamp and audible alarm will activate. SHUT DOWN EXPERIMENT AS RAPIDLY AS POSSIBLE. Close sash. Report condition to Safety Office personnel.

F. Signage:
   1. Lettering: Manufacturer's standard lettering, background colors, and mounting.
   2. Signage Messages: In accordance with requirements of NFPA 45.

2.10 ACCESSORIES

A. Ceiling Enclosures: Provide ceiling enclosure with removable access panel located on the lower portion of the front panel.
   1. Color and finish to match fume hood structure.
   2. Ceiling enclosures shall extend to within 1 inch of acoustical lay-in ceiling. Field dimension before manufacture of ceiling enclosures.

B. Distillation Rack:
   1. Provide lattice rod assemblies of solid 1/2 inch aluminum rod. Reference Fume Hood Schedule for locations.

2.11 SOURCE QUALITY CONTROL

A. Test one fume hood of each type manufactured according approved shop drawing before shipment.

B. Factory Testing Requirements:
   1. Test Room: Set up test hood in a test room of sufficient size with a minimum of 5 feet clear space in front of the hood and on both sides of the hood for viewing the test.
   2. ASHRAE 110- As Manufactured (AM) test shall includes.

2.12 SOURCE QUALITY CONTROL

A. Test one fume hood of each type manufactured according approved shop drawing before shipment.

B. Factory Testing Requirements:
   1. Test Room: Set up test hood in a test room of sufficient size with a minimum of 5 feet clear space in front of the hood and on both sides of the hood for viewing the test.
   2. ASHRAE 110- As Manufactured (AM) test shall includes.
      a. Exhaust Stability Test
      b. Local Visualization Challenge (Low -Volume Smoke Test).
      c. Large-Volume Visualization Challenge (High-Volume Smoke Test).
      d. Face Velocity Testing:
         1) 100 ft/min; with deviation of plus or minus 20 ft/min.
      e. Tracer Gas Containment Testing:
         1) Test to a control level of AM 0.05 ppm or better.

C. Static Pressure Loss for Bench Mounted Fume Hoods:
   1. Face velocity of 75 ft/min: Maximum 1.4 inch of water gauge.
   2. Face velocity of 100 ft/min: Maximum 1/2 inch of water gauge.
   3. Face velocity of 120 ft/min: Maximum 1/2 inch of water gauge.
   4. Constant volume fume hoods with bypass: Static pressure and exhaust volume shall be relatively constant regardless of sash position.

D. Face Velocity at Sash Opened 6 inch: Maximum 3 times face velocity at sash fully opened.

E. Provide documentation showing the test result. Report of tests previously performed on the same design are acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify equipment rough-in before proceeding with work, including rough opening dimensions required for fume hood installation.

B. Coordinate for proper installation of mechanical, plumbing and electrical services.

3.2 PREPARATION

A. Repair, replace, and fix irregularities that will affect the quality of the execution of the work specified.

3.3 INSTALLATION

A. Install fume hoods, plumb, level, rigid, securely anchored to building and adjacent furniture in locations indicated.

B. Provide filler panels between top of hood and ceiling.

C. Securely attach access panels but provide for easy removal and secure re attachment.

D. Do not install any damaged units.

E. Affix one copy each of the following to an unobscured exterior side panel of each fume hood prior to Substantial Completion.
   1. "Prudent Practices in the Laboratory: Handling and Disposal of Chemicals," National Research Council, Washington, DC.; National Academy Press, 1995: www.nap.com.

3.4 INTERFACE WITH OTHER WORK

A. Coordinate with the schedule and other requirements of other work being performed in the area including, but not limited to, casework and work surface installation, mechanical and electrical connections to and in the fume hoods.

3.5 FIELD QUALITY CONTROL

A. Fume Hood Performance Testing Requirements:
   1. Test fume hoods after installation of fume hoods is complete, and the building ventilation and control system has been balanced, and utilities and services connections have been made.
   2. Test fume hood in accordance with SEFA 1 recommendations.
   3. Use ANSI/ASHRAE 110-1995 Method of Testing Performance of Laboratory Fume Hoods to determine a benchmark performance.

B. Testing Responsibilities:
   1. ASHRAE 110, As Installed (AI) test: By Fume hood Manufacturer.
      a. Test all fume hood units installed in the Work of this Project.
      b. (AI) Test methods includes:
         1) Face Velocity Measurements.
            a) Face velocity grid test: 100 ft/min; with deviation of plus or minus 20 ft/min.

C. Correcting Deficiencies and Retest:
   1. If test results of testing specified above are not satisfactory, Fume hood manufacturer and Contractor shall take the following actions:
      a. Determine probable cause of deficiencies.
      b. Generate solutions for the problems determined in step "a" above.
      c. Implement a mitigation plan that include the solutions in step "b" above.

   2. Retest the fume hoods and compare the pre- and post-mitigation results to determine the effectiveness of the remedial work on the fume hoods.
   3. Repeat the effort until test result is accepted by owner.
   4. Remedial work and retest shall not add cost and time delay to the Owner.

3.6 ADJUSTING AND CLEANING

A. Adjust operating equipment and moving parts, with the exception of air handling motors, for smooth and efficient operation for intended use.
   1. Sashes: Smooth, near-silent, and accurate operation with one hand and uniform contact of rubber bumpers. Ensure counterbalances operate without interference.
   2. Vertical-Rising Sashes: Operate smoothly without tilting when raised or lowered from either end; remain at rest in any open position.
   3. Horizontal Sliding Sashes: Operate smoothly without binding.
   4. Baffles: Set with all openings adjusted to maximum open position.

B. Clean equipment, casework, work surfaces, light fixture lens, both sides of sash, and other surfaces as recommended by manufacturers, rendering work in new and unused appearance.

C. Clean adjacent construction and surfaces soiled in the course of installation of this work.

D. Touch up minor damaged surfaces caused by installation.

E. Replace damaged and defective components that cannot be repaired to new condition.

3.7 PROTECTION

A. Provide protective measures to prevent equipment and surfaces from exposure to other construction activity.

3.8 DEMONSTRATION AND TRAINING

A. Demonstrate fume hood operations and functions to Owner designated representatives at completion of installation.

END OF SECTION 11 53 00

SECTION 12 21 13- WINDOW BLINDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Horizontal miniblinds.
   2. Accessories necessary for a complete installation.

1.3 SUBMITTALS

A. Product Data: Technical data for each type of product.

B. Shop Drawings: Submit fabrication and installation details.
   1. Motorized Operators: Include details of installation in headrails and include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified, 12 inches (300 mm) long.
   1. Slat: Not less than 12 inches (300 mm) long.
   2. Tapes: Full width, not less than 6 inches (150 mm) long.
   3. Horizontal Louver Blind: Full size unit, not less than 16 inches (400 mm) wide by 24 inches (600 mm) long.
   4. Valance: Full-size unit, not less than 12 inches (300 mm) wide.

D. Product Test Reports: For horizontal louver blinds with polymer slats that have been tested for compliance with NFPA 701, for tests performed by.

E. Maintenance Data: Submit data to include in maintenance manuals.

1.4 **QUALITY ASSURANCE**

A. Source Limitations: Obtain horizontal louver blinds from single source from single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver horizontal louver blinds in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet-work and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where horizontal louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from

Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 EXTRA MATERIALS

A. Furnish extra materials**,** from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Horizontal Louver Blinds: Full size units equal to 5 percent of quantity installed for each size, color, texture, pattern, and gloss indicated, but no fewer than two units.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Horizontal Louver Blinds, Aluminum Slats:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CACO, Inc., Window Fashions; (423) 926-2810.
   b. Hunter Douglas Contract; (800) 727-8953.
   c. Levolor Contract; a Newell Rubbermaid company; (800) 826-8021.
   d. Springs Window Fashions; SWFcontract; (877) 792-0002.

2. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radius corners.
   a. Width: 1 inch (25 mm).
   b. Thickness: Not less than 0.006 inch (0.15 mm).
   c. Spacing: Standard.

3. Finish: Reflective finish on outside facing surface of slat to enhance reflection of solar energy.

4. Features:
   a. Lift Cord Rout Holes: Minimum size required for lift cord and located near back (outside) edge of slat to maximize slat overlap and minimize light gaps between slats.
   b. Perforated Slats: Openness factor of 6 to 7 percent.

5. Tilter: Wand-type shall be operated by a length of transparent extruded plastic rod with a multi-sided cross-section measuring approximately 3/8 inch across points for comfortable grip. Plastic wand shall be easily detachable by means of a wand link and sliding crystal sleeve. Tilter shall be snap-fitted to headrail using no rivets or metal cleats.

6. Braided Ladders:
   a. Distance between end ladder and end of slats shall not exceed six (6) inches.
   b. Distance between ladders shall not exceed 22 inches.
   c. Material shall be polyester yarn. Vertical component shall be not less than 0.045 inch diameter nor greater than 0.066 inch diameter.

7. Cord lock and tilter operation locations: Tilter at left, cord lock at right (standard).

8. Installation brackets: End support, hinged cover brackets 0.042 inch thick treated steel with prime coat of epoxy primer and finish coat of polyester baked enamel in color to match headrail. Brackets shall be marked left and right to facilitate installation and shall have a 1-1/4 inch extra-wide top to accommodate power screwdriver.

9. Intermediate support brackets: Brackets shall be furnished for blinds over 60 inches wide. Maximum spacing for intermediate support brackets shall be 48 inches.

10. Install valance brackets and double blade stacked slats at top of all blinds.

11. Outside of Jamb Installation: Width and length as indicated, with terminations between blinds of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install blinds at locations scheduled, noted on the drawings, or as directed by the Architect in accordance with manufacturer's installation procedures, except as otherwise specified herein.

B. Install intermediate support and extension brackets as needed to prevent deflection in headrail.

C. Install blinds with adequate clearance to permit smooth operation of blinds and any sash operators. Hold blinds 1/4 inch clear from each side of window opening on inside mount, unless other clearance is indicated.

D. Set tilt and locking controls.

3.2 CLEANING AND DEMONSTRATION

A. Clean blinds in accordance with manufacturer's instructions.

B. Provide final protection and maintain conditions that ensures that horizontal louver blinds are without damage or deterioration at time of Substantial Completion.

C. Replace damaged horizontal louver blinds that cannot be repaired in a manner approved by Architect before time of Substantial Completion.

3.3 DEMONSTRATION

A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems.

END OF SECTION 12 21 13

SECTION 12 35 53 - LABORATORY CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Wood casework.

B. Epoxy resin work surfaces.

C. Epoxy resin sinks, drain outlets.

D. Service fittings.

E. Accessory items as specified herein.

1.3 RELATED SECTIONS

A. Section 06 10 00 - Rough Carpentry: Blocking within walls to adequately support casework.

B. Section 08 71 00 - Finish Hardware: Refer for Owner's keying system for locks.

C. Section 09 65 19 - Resilient Tile Flooring and Base: Furnishing and installing rubber base.

D. Section 12 35 50 - Educational Casework

E. Division 22 - Mechanical:
   1. Furnishing and installation of piping, drainline, traps, final connections and setting of sinks and fixtures.
   2. Furnishing and installation of exhaust ductwork, transition(s), blowers and equipment, and final connection to fume hood(s).

F. Division 26 - Electrical: Furnishing and installation of electrical wiring, conduit and/or electrical items and final connections.

1.3 REFERENCES

A. American Disabilities Act (ADA)
   1. American Disabilities Act Design Guidelines (ADADG).

B. American National Standards Institute (ANSI)
   1. American National Standards Publications.

C. American Woodwork Institute
   1. Architectural Woodwork Quality Standards.

D. SEFA (Scientific Equipment and Furniture Association) standards.
   1. SEFA 1.2 – Fume Hoods.
   2. SEFA 2.3 – Installation of Scientific Laboratory Furniture and Equipment.
   3. SEFA 3 – Work Surface.
   4. SEFA 7 – Laboratory and Hospital Fixtures.
   5. SEFA 8 – Laboratory Furniture.

1.4 DEFINITIONS

A. Definitions of cabinet components by surface visibility:
   1. Exposed Surfaces:
      a. Surfaces visible when drawers and solid doors are closed.
      b. Surfaces visible behind clear glass doors.
      c. Interior surfaces of open units.
      d. Bottoms of cabinets 42 inches or more above finished floor.
      e. Tops of cabinets less than 78 inches above finished floor, or are visible from an upper floor or staircase after installation.
      f. Front edges of cabinet body members visible though a gap greater than 1/8 inch with doors and drawers closed.
      g. Surfaces visible when fixed appliances are installed.

   2. Semi-exposed Surfaces:
      a. Surfaces visible when doors are open.
      b. Bottoms of cabinets 30 inches - 42 inches above finished floor.
      c. All front edges of shelving behind doors.

   3. Concealed Surfaces:
      a. Surfaces not normally visible after installation.
      b. Bottoms of cabinets less than 30 inches above finished floor.
      c. Tops of cabinets over 78 inches above finished floor which are not visible from an upper level.
      d. Stretchers, blocking, components concealed by drawers.

1.5 SUBMITTALS

A. Manufacturer's Compliance Statement:
   1. Pre-qualified manufacturers whose name appears below under acceptable Manufacturers shall provide statement of compliance as scheduled by General Contractor; or
   2. Manufacturers requesting substitution of products shall submit statement of compliance at proposal time in accordance with Division 1 requirements for substitutions.

B. Shop Drawings: Provide large scale plans and elevations of casework, cross sections, rough-in and anchor placements, tolerances and clearances. Indicate relationship of units to windows, doors, surrounding walls and other building components.

C. Product Data: Submit manufacturer's catalog for reference. Include cabinet dimensions, configurations, construction details, joint details, attachment details, and rough-in details as required.

D. Product Samples to be submitted for approval (One (1) each):
   1. Worktop: Four (4) inch x four (4) inch sample of each material.

2. Finish: Three (3) inch x five (5) inch sample of each available standard stain color with finish for Architect's selection.
3. Provide an actual sample of a cabinet in the color and finish selected for Architect's approval. Approved cabinet color and finish will be basis for which all work will be judged. Approved sample cabinet may be used in the work. All cabinets shall match in color and finish to that of the approved sample and if found to vary in color, i.e., too light or too dark shall be refinished to match approved sample at no expense to Owner.
4. Hardware: Pulls, locks and hinges. Locks shall be keyed alike and masterkeyed to Owner's keying system as specified in Section 08 71 00.

1.6 QUALITY ASSURANCE

A. Single source: Casework and fume hoods to be manufactured and furnished by a single laboratory furniture company.

B. Manufacturer's qualifications: Modern plant with proper tools, dies, fixtures and skilled production staff to produce high quality laboratory casework and fume hoods, and shall meet the following minimum requirements:
1. Minimum of ten (10) years experience in manufacture of wood laboratory casework and fume hoods.
2. Ten (10) installations of equal or larger size.

C. Installer qualifications: Certified by the manufacturer.

D. Manufacturer to provide load test results certified by an independent testing laboratory for drawers, doors, suspension slides and unit shelving.

E. Casework construction and performance characteristics shall be in full compliance with SEFA 8 standards. At the Owner's request, independent, third part testing must be submitted validating compliance and adheres to the architectural specifications.

1.7 PROJECT CONDITIONS

A. Do not deliver or install wood product until the following conditions are met:
1. Windows and doors are installed and the building is secure and weathertight.
2. Ceiling, overhead ductwork and lighting are installed.
3. All painting is completed and floor tile is installed.
4. Interior building temperature to be between 65 degrees F and 80 degrees F, and ambient relative humidity maintained between 25 percent and 55 percent prior to delivery, and during and after installation. Frequent and/or excessive changes in temperature and/or humidity levels during casework installation, or once casework is installed, shall be avoided to prevent damage to materials.

B. Field measurements shall be taken to verify that the equipment will fit into the designated space. Entryways, corridors and door openings shall be verified to ensure that the equipment be manufactured in a manner to permit it to be moved through properly into place.

1.8 DELIVERY, STORAGE AND HANDLING

A. Delivery: Schedule delivery so rooms are sufficiently complete that material can be installed immediately following delivery.

B. Casework: Protect finished surfaces from soiling or damage during handling and installation.

C. Work surfaces: Protect throughout the construction period.

1.9 WARRANTY

A. Warrant casework against becoming unserviceable or causing an objectionable appearance resulting from defects in materials and workmanship, including workmanship of installation. Materials provided by Casework Manufacturer shall carry a warranty for five (5) years from date of Substantial Completion. Other materials and equipment shall carry warranty by the product manufacturer.

B. Defects shall include, but not limited to:
1. Discoloration of finish.
2. Missing or loose parts.
3. Noisy or hard operation of moving parts.
4. Failure to meet specifications.

PART 2 - PRODUCTS

2.1 APPROVED PRODUCT/MANUFACTURERS

A. Design, materials, construction and finish of casework as specified represents the minimum acceptable standard of quality for wood laboratory casework.

B. Basis of Design Manufacturer: Sheldon Laboratory Systems**,** Crystal Springs, MS, (601) 892-2731. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
1. Campbell Rhea Caseworks.
2. Collegedale Casework LLC.
3. Diversified Woodcrafts, Inc.
4. Hamilton Laboratory Solutions, LLC.
5. Kewaunee Scientific Corp.
6. Leonard Peterson & Co.
7. South Texas Woodmill, Inc.
8. TMI Systems Corporation.

2.2 CASEWORK DESIGN

A. Door and Drawer Design:
1. Lipped Overlay: Partial overlay design with 3/8 inch reveals between door or drawer and frame, door to door, door to drawer, drawer to drawer; 7/16 inch vertical reveal between doors/drawers and cabinet ends.

B. Standard grain pattern on end panels is vertical.

C. Grain pattern on cabinet fronts:
1. Combination Grain: Horizontal grain on drawer fronts, vertical grain on door fronts.

D. Cabinet end panels exposed to view after installation shall be specified as a "finished

end" panel. All end panels not exposed to view after installation shall be as listed under "unexposed" plywood.

E. Cabinets to be rigid, self-supporting design for use in assembly or as single, interchangeable stand-alone units.

F. Flush Interiors: Surface mounted bottoms and offsets caused by front face frames which interfere with ease of cleaning are not acceptable.

G. Joinery: 32mm doweled joinery system glued, clamped and screwed. Dowels are to be hardwood, laterally fluted with chamfered ends and a minimum diameter of 8mm.

H. Where shown or required, provide products conforming to ADADG for barrier-free design.

2.3 CASEWORK MATERIALS

A. Hardwood:
1. Lumber core shall conform to ANSI/HPVA HP-1 product standards.
2. Hardwood lumber, clean and free of defects. All lumber kiln-dried to uniform moisture content of six (6) percent.
   a. Exposed material: Red Oak, Grade I minimum.
   b. Semi-exposed material: Select hardwood.
   c. Unexposed material: Sound hardwood of species suitable for the intended purpose.

B. Plywood:
1. Hardwood plywoods shall conform to ANSI/HPVA HP-1 product standards.
2. Core: 7-ply (3/4 inch thick) and 9-ply (one (1) inch thick) veneer core plywood with cross and face plies bonded with Type II water-resistant glue; drawers are 9-ply, 1/2 inch thick.
3. Face veneer:
   a. Exposed surfaces: Plain-sliced red oak veneer, grade A, selected for golden wheat color and narrow hearts.
   b. Semi-exposed: Same species as specified for exposed face veneer, grade 2 for oak.
   c. Unexposed: Same species as specified for exposed and semi-exposed veneer, grade at option of manufacturer.

C. Welded fiberboard: Tempered welded fiber shall be wood fibers and natural resin binding agent compressed into dense homogeneous sheets. Sheets are impregnated with a special tempering compound polymerized by baking to give exceptional strength, and shall conform to ANSI/AHA A135.4 Basic Hardboard for Class 1 tempered grade.

D. Glass: 7/32 inch for tall cases and unframed wall and upper case doors, 1/8 inch for framed wall and upper case doors, without imperfections or marred surfaces of clear float glass.

E. Glue: Laminating - Type II water-resistant; assembly - Type III water-resistant.

F. Edgebanding: 3mm hardwood of same species as exposed face veneers.

G. Finish: Highly chemical-resistant modified acrylic urethane finish with built in U.V. blocker or equal finish applied over stain of selected color. Finish shall meet

performance characteristics of TR-5, Section 1500, AWI Architectural Woodwork Quality Standards (latest edition).

2.4 CASEWORK FABRICATION

A. Base Units:

1. Cabinet ends: 3/4 inch thick plywood with 3mm hardwood banding on front edges. Bore interior faces, as appropriate, for security panels, rails, and four rows of shelf support holes:
2. Levelers: Provide four (4) metal corner gusset levelers with threaded adjustment screws and floor pad on all base cabinets.
3. Top rails:
   a. Full Top Frame:
      1) Horizontal front top rail: One (1) inch x three (3) inch solid hardwood. Attach to cabinet ends with glued 8mm dowel joinery and screws.
      2) Vertical back top rail: 3/4 inch x 3-3/4 inch hardwood. Attach to cabinet ends with glued 8mm dowel joinery and screws.
      3) Top side rails: 3/4 inch x 1-1/2 inch hardwood between front horizontal and back vertical rails, glued and screwed in place.
4. Intermediate rails: Front horizontal intermediate rail: 3/4 inch x 1-1/2 inch exposed hardwood rail to be provided between doors and drawers. Secure to cabinet end panels with glued 8mm dowel joinery.
5. Toe space rail: 3-3/4 inch x 3/4 inch hardwood or 7-ply veneer core plywood, mounted between end panels with glued 8mm dowel joinery and metal fasteners, forming a 4 inch high x 2-1/2 inch deep toe space, closed to cupboard bottom.
6. Bottoms: 3/4 inch thick plywood, set flush and joined to cabinet end panels with glued 8mm dowels on 96mm spacing and metal fasteners. Front edge to be banded with 3mm hardwood banding.
7. Backs:
   a. Cupboard units: One-piece 3/16 inch thick hardboard, rabbetted into rear top rail for easy removal from inside of cabinet.
   b. Drawer units: Open back.
   c. Sink units: Half-height, one piece 3/16 inch thick hardboard, rabbetted into rear rail for easy removal from inside of cabinet.
8. Vertical dividers in combination cabinets: 1-1/2 inch thick plywood panel (frames not permitted) glued and screwed in place, top and bottom, with 3mm hardwood banding on front edge.
9. Security panels: None required.
10. Shelves (for base units): Veneer core plywood, 3mm hardwood banded on front edge, adjustable on 32mm centers:
    a. Full-depth shelf, 17-3/4 inches deep.
    b. Thickness: 3/4 inch thick for all shelves up to and including 30 inches wide, one (1) inch thick for all shelves over 30 inches wide.
    c. 1/2 inch wide x 1/2 inch high raised lip on all four (4) sides of shelves for spill containment.
11. Drawer construction:
    a. Box: Four-sided drawer box with back, front and sides of 12mm (1/2 inch nominal) 9-ply Birch plywood with chemical-resistant finish and finished top edges. (Three-sided drawer box attached to outer drawer front is not acceptable.) Sides shall be joined by Lock joint, glued and

pinned.

b. Bottom: Nominal 1/4 inch, inset into all four (4) sides of drawer box and sealed with hot melt glue process around entire drawer bottom perimeter. Material to be white melamine-clad tempered hardboard.

12. Door and removable drawer front construction: 3 ply 3/4 inch thick (door) and 1/2 inch thick (drawer), particleboard core, hardwood framed all four (4) sides, face veneer on both surfaces, radiused edges all four (4) sides; doors to be routed on inside perimeter to allow 1/4 inch inset into door opening.

B. Hardware:

1. Drawer suspension: 3/4 extension, open roller, 75 lb. dynamic load, self-closing epoxy- coated Blum 230 series or equal on all drawers except file drawers. All file drawers to have full extension with overtravel, ball-bearing roller, 150 lb. dynamic load, zinc-plated Accuride 4034 series, or Architect approved equal.
2. Drawer and hinged door pulls: Satin chrome wire pulls.
3. Hinges: Provide two (2) hinges for doors up to 48 inches high; three (3) hinges or doors over 48 inches high. Notch for proper fit. 5-knuckle, institutional stainless steel hinges.
4. Unit shelf supports: Metal pin and socket.
5. Door catches: Adjustable, spring-actuated nylon roller.
6. Elbow catches: Spring type with strike.
7. Locks, where indicated on drawings: 5-pin tumbler keyed alike and master keyed to Owner's keying system specified in Section 08 71 00.

2.5 EPOXY END SINKS

A. Model: 952C0730 End Sink Assembly. Center type, consisting of the following:

1. 52L48100 Epoxy Sink
2. 520C0180 Leg Assembly, End 17.810
3. 952C073A Frame Assembly

2.6 MECHANICAL SERVICE FITTINGS

A. Manufacturer: Chicago Faucet Co., vandal resistant.

B. Laboratory Service Fittings:

1. Service fittings shall be laboratory grade, and water faucets and valve bodies shall be cast red brass alloy or bronze forgings, with a minimum content of 85%. All fittings shall be chromium plated unless specified otherwise.

C. Water Fittings:

1. Water fittings shall be provided with a renewable unit containing all operating parts which are subject to wear. The renewable unit shall contain an integral volume control device and all faucets shall be capable of being readily converted from compression to self-closing, without disturbing the faucet body proper. Four (4) arm forge brass handles shall contain plastic screw-on type colored service index buttons.

D. Ground Key Valve Hose Cocks:

1. Ground key type valves shall have forged body with 10 serration hose end. Handle plug shall be forged brass, long, tapered type with screw-on colored service index button. Valves shall be individually ground, lapped and sealed.

E. Needle Valve Hose Cocks:

1. Needle type valves shall have a stainless steel replaceable floating cone, precision finished and self-centering. Cone locates against a stainless steel seat, easily removable and replaced with a socket wrench. Valve shall have “Teflon” impregnated packing and designed so unit can be repacked while under pressure.

F. Gooseneck Type Outlets: Gooseneck outlets shall have a separate brazed coupling to provide a full thread attachment of anti-splash, serrated tip or filter pump fittings.

G. Remote Control Valves: All valves for remote control use shall be as previously specified, but shall be complete with brass extension rods, escutcheon plates, brass forged handles and screw-on type colored service index button.

H. Tank Nipples: Tank nipples shall be provided with locking nut and washer for all fixtures where fittings are anchored to equipment.

I. Service Indexes: Fittings shall be identified with service indexes in the following color coding:

Hot Water	Red
Cold Water	Dark Green
Gas	Dark Blue
Air	Orange
Vacuum	Yellow
Distilled Water	White
Steam	Black
Nitrogen	Gray
Oxygen	Light Green
Hydrogen	Pink
Special Gases	Light Blue

J. Electrical Fittings: Electrical fittings shall contain 20 Amp., 125 Volt AC, 3-wire polarized grounded receptacles, unless otherwise specified. Pedestal and line-type boxes shall be of aluminum, metallic finish with stainless steel flush plates. Receptacle boxes shall be of plated steel. All electrical or conduit fittings called for or to be furnished under these specifications shall meet the requirements of the National Electrical Code.

K. Sink Outlets: Unless otherwise specified, sink outlets for other than stainless steel sinks shall be Molded Epoxy Resin, with integral cross bars, tapered for overflow and be complete with gasket and lock nut with 1-1/2 inch I.P.S. male straight thread outlet. Overflows shall not be furnished for sink outlets unless specifically called for.

L. Crumb Cup Strainers: Crumb cup strainers shall be stainless steel or chromium plated brass, as specified and shall be furnished for stainless steel sinks, and be complete with gasket, lock nut and 4 inch long unthreaded tailpiece outlet in 1-1/2 inch size.

M. Vacuum Breakers: Vacuum breakers when specified to be required, shall be the ‘Nidel or Watts’ type unless specified to be an integral part of gooseneck fixture with a renewable seat and fine flow control.

N. Aerator Outlets: Aerator type outlets shall be furnished for all gooseneck water faucets nor furnished with serrated hose connectors.

2.7 WORKSURFACES

A. Epoxy Resin Tops: Factory molded tops of modified epoxy resin formulation, uniform mixture throughout full one (1) inch thickness. Color shall be non-glare black. Cast surfaces shall be very smooth, with factory cutouts for sinks and drip grooves. Plain butt type joints assembled with epoxy adhesive.

2.8 PHYSICS TABLES

A. Dimensions: Modified to 48 inches wide by 42 inches deep by 30 inches high.

B. Top Surface: Black epoxy resin work surface with two (2) inch overhang to accommodate clamping of accessory apparatus.

C. Accessories:
1. Three (3) upright rods with crossbars and clamps.
2. Two (2) variable voltage units.

D. Approved Product/Manufacturer: Model 942C2020 Modified as manufactured by Fisher Hamilton L.L.C., Two Rivers, WI; (920) 793-1121, or Architect approved equal.

2.9 FOUR-STUDENT LAB TABLES

A. Type: Accommodates up to four (4) students in each of four (4) classes.

B. Manual Height Adjustments: Manual crank mechanism adjustment from 30 inches to 36 inches.

C. Top Surface: One (1) inch thick by length and width as indicated on the drawings, black epoxy resin top with raised edge.

D. Sink Assembly with two (2) unicast fixtures and two (2) duplex gfi electrical outlets. (Trap not included)
1. Two (2) c-clamp upright rod assemblies.

E. Approved Product/Manufacturer: Axis 3 Table Model 16710 (84” length x 50” width) or Model 16100 (96” length x 50” width) as manufactured by Sheldon Laboratory Systems, Crystal Springs, MS; (601) 892-2731, or Architect approved equal, in size to match existing.

2.10 EMERGENCY DRENCH SHOWER AND EYE WASH COMBINATIONS

A. Kewaunee Model No. W-0926-00 (Chicago No. 82LC92186).

B. Provide at locations as indicated on the drawings.

2.11 EMERGENCY DRENCH SHOWER AND EYE WASH COMBINATIONS - LABORATORY

A. Bradley Model No. S19-310FW

B. Provide at locations as indicated on the drawings.

2.12 EMERGENCY EYE WASH COMBINATIONS – PREP ROOMS

A. Bradley Model No. S19-270B

B. Provide at sink in prep rooms as indicated on the drawings.

2.14 EMERGENCY DRENCH SHOWER AND EYE WASH COMBINATIONS

A. Number/Location: Provide one (1) at Science Lab, unless indicated otherwise on drawings.

B. Fisher-Hamilton Watersaver Colortech No. 28L19200 ADA Accessible Free Standing Eye Wash/Body Shower or equivalent by Chicago Faucet, or Architect approved equal.

2.15 EMERGENCY EYE WASH

A. Number/Location: Provide one (1) in Science Prep Room unless indicated otherwise on drawings.

B. Approved Product/Manufacturer: Fisher-Hamilton Watersaver No. 32L34300 Panel Mounted Eye Wash or equivalent by Chicago Faucet, or Architect approved equal.

2.16 ACID STORAGE UNIT

A. Owner Furnished, Contractor Installed.

2.17 SAFETY GOGGLE COMPARTMENT CASES

A. Owner Furnished, Contractor Installed.

2.18 FIRE BLANKETS

A. Owner Furnished, Contractor Installed.

2.19 FLAMMABLE STORAGE CABINET

A. Owner Furnished, Contractor Installed.

2.20 ACID STORAGE UNIT

A. Description: Cabinet shall be constructed of one (1) inch thick high-density 9-ply plywood with interior completely lined with polypropylene (floor, interior walls, interior top and top tray

B. Dimensions:
   1. Exterior: 36-1/2 inches high x 31 inches wide x 20 inches deep.
   2. Interior: 28-1/2 inches high x 29 inches wide x 17-1/4 inches deep.

C. Bottle Capacity: (30) 5 pint or (90) 1 pint.

D. Features:
   1. Recessed wooden door handle.
   2. Word “ACID” printed on cabinet with six (6) inch red letters.
   3. All wooden hinges.
   4. Four (4) leveling feet.

E. Location: As shown on drawings.

F. Approved Product/Manufacturer: Cabinet SC8051, with Nitric Acid Compartment Model SC8071 as manufactured by Flinn/SciMatCo, Batavia, IL; (888) 879-7620, or Architect approved equal.

2.21 SAFETY GOGGLE COMPARTMENT CASES

A. Type/Construction: Provide 15 minute Timer

B. Dimensions: 28-1/2 inches H x 26-1/4 inches W x 10-1/4 inches D

C. Number/Location: As shown on drawings.

D. Fasteners: Of type, size, and finish recommended by manufacturer to suit application.

E. Approved Product/Manufacturer: Model # SE-1000 furnished with 36 pairs of SE1049 non-ventilated goggles with fog-free lens as manufactured by Flinn Scientific, Inc., or Architect approved equal.

2.22 FIRE BLANKETS

A. Type: Fire blanket in a metal container that easily mounts to wall.

B. Door: Drop hinge door allows for quick and easy access.

C. Blanket Size/Type: 66 inches wide x 72 inches long fire retardant-treated woolen blanket for smothering fires.

D. Number/Location: One (1) wall mounted in each Lab as shown on drawings.

E. Approved Product/Manufacturer: Model # SE3006 as manufactured by Flinn Scientific, Inc., Batavia, IL; (800) 452-1261, or Architect approved equal.

2.23 FLAMMABLE STORAGE CABINET

A. Description: Wooden Floor cabinet
   1. Dimensions:
      a. Exterior: 23-7/8 inches wide x 23-7/8 inches deep x 36-5/6 inches high.
      b. Interior: 21-7/8 inches wide x 21 inches deep x 34 inches high.
   2. Bottle Capacity: 18 gallons.

B. Features:
   1. Two (2) doors.
   2. Two (2) inch floor spill retention trough.
   3. One (1) adjustable shelf.
   4. Meets NFPA and OSHA standards.

C. Location: As shown on drawings.

D. Approved Product/Manufacturer: Floor Cabinet Model SC7021, with Nitric Acid Compartment Model SC8071 as manufactured by Flinn/SciMatCo, Batavia, IL; (888) 879-7620, or Architect approved equal.

2.24 INSTRUCTOR AND DEMONSTRATION DESK

A. Approved Product/Manufacturer: Sheldon Laboratory Systems Model No. 16500 Focal Point Demonstration Desk, or Architect approved equal.
   1. 10’ length x 66” wide x 34” height.
   2. 1” black molded epoxy resin top.
   3. Sink assembly with unimix HW, CW, gas fixture.
      a. Cantilevered half round black Shelresin sink (22” L x 14-1/2” W x 5-1/2” D) I.D. with sink outlet
      b. Unimix #80030 combination hot water, cold water and gas fixture with wrist blade handles and soft flow aerator.
      c. 110V #85101-gfi duplex electric outlet
      d. One (1) upright rod assembly set consisting of two upright rods with integral C-clamp and one horizontal rod with two connectors.
      e. Trap not included.
   4. Recessed rotating monitor well with hood and remote wireless keyboard.
   5. Three storage cabinets.
   6. Two tambour door storage cabinets with pullouts for printer.
   7. All units with locks.

2.25 LABORATORY PEGBOARD

A. Approved Product/Manufacturer: Fisher-Hamilton Model No. 52L77900 Laboratory Pegboard consisting of 1 inch thick black resin pegboard (36 inches by 36 inches) with (38) 5 inch long polypropylene pegs.

2.26 J-FRAME SUPPORT SYSTEMS

A. General: The ‘J’-frame support structure shall consist of vertical (inverted ‘J’) support members and horizontal tubular frames.

B. Vertical ‘J’ Support Members:
   1. Vertical ‘J’ support members shall be 16 gauge, 1-1/4 inch square Type 304 stainless steel seamless tubing, heliarc welded where required, ground smooth at all joints and given a satin finish.
   2. The vertical support members shall be formed into an inverted ‘J’ maintaining a smooth contour without warp or twist in the metal. Each vertical support shall have a 1 inch height adjustment for handling various floor conditions and be so designed as to maintain a fixed position on the floor. A concealed ‘hold-down’ angle or other means will be acceptable. Molded vinyl tapered leg shoes shall be furnished at each support leg to conceal the adjustment device and/or ‘hold-down’ angle. Each support shall have two 5/16 inch - 18 stud bolts supplied for each side for securing the horizontal frames. Cap nuts shall be furnished for all exposed studs.

C. Horizontal Frames: All horizontal frames shall have a 1-1/4 inch square tubing front and rear members. Horizontal frames shall be 16 gauge, Type 304 stainless steel, heliarc welded throughout ground smooth at all joints and given a satin finish.

D. “J”-Frame Performance Requirements: The support structure shall be designed for heavy-duty laboratory usage, and when a wall table is completely assembled with work

top and cabinets in place, it shall support the following loads:

1. A 7 foot long wall table assembly with 4 foot and 3 foot modular spacing shall support a load of 1,500 lbs. uniformly distributed over the work top area.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Casework installation:
   1. Set casework components plumb, square, and straight with no distortion and securely anchored to building structure. Shim as required using concealed shims.
   2. Fasten continuous cabinets together with joints flush, tight and uniform, with alignment of adjacent units within 1/16 inch tolerance.
   3. Secure wall cabinets to solid supporting material, not to plaster, lath or gypsum board. Blocking in wall by rough carpentry as specified in Section 06 10 00.
   4. Abut top edge surfaces in one true plane. Provide flush joints not to exceed 1/8 inch between top units.

B. Work surface installation:
   1. Where required due to field conditions, scribe or caulk to abutting surfaces.
   2. Secure joints in the field, where practicable, in the same manner as in factory, with dowels, adhesive or fasteners recommended by manufacturer.
   3. Secure work surfaces to casework and equipment components with material and procedures recommended by the manufacturer.

C. Sink installation: Sinks shall be set in chemical-resistant sealing compound, secured and supported per manufacturer's recommendations.

D. Accessory installation: Install accessories and fittings in accordance with manufacturer's recommendations. Turn screws to seat flat; do not drive.

3.2 ADJUSTING

A. Repair or remove and replace defective work, as directed by Architect upon completion of installation.

B. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly.

3.3 CLEANING

A. Broom clean finished casework, touch up as required.

B. Clean materials as recommended by manufacturer.

3.4 PROTECTION OF FINISHED WORK

A. Provide necessary protective measures to prevent damage of casework and equipment from exposure to other construction activity.

B. Advise contractor of procedures and precautions for protection of material, installed laboratory casework and fixtures from damage by work of other trades.

END OF SECTION 12 35 53

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Presealed Systems.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

   a. Piping Smaller Than NPS Galvanized-steel wall sleeves.
   b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves.

2. Exterior Concrete Walls below Grade:

   a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system.

      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

   b. Piping NPS 6 and LargerGalvanized-steel wall sleeves with sleeve-seal system.

      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

   a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.

5. Interior Partitions:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-platedfinish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-platedfinish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

SECTION 220523 GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Bronze ball valves.
   2. Bronze lift check valves.
   3. Bronze swing check valves.
   4. Bronze gate valves.

B. Related Sections:
   1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
   2. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B31.1 for power piping valves.
   2. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set gate valves closed to prevent rattling.
   4. Set ball valves open to minimize exposure of functional surfaces.
   5. Block check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

B. Valve Sizes: Same as upstream piping unless otherwise indicated.

C. Valve Actuator Types:
   1. Handwheel: For valves other than quarter-turn types.
   2. Handlever: For quarter-turn valves NPS 6 and smaller.

D. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   1. Gate Valves: With rising stem.
   2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

E. Valve-End Connections:
   1. Grooved: With grooves according to AWWA C606.

2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

F. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
1. Description:
a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

2.3 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:
1. Description:
a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.4 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:
1. Description:
a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.5 BRONZE GATE VALVES

A. Class 125, RS Bronze Gate Valves:
1. Description:
a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig.

c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:
1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball or gate valves.
   2. Throttling Service: Ball valve.
   3. Pump-Discharge Check Valves:
      a. NPS 4 and Smaller: Bronze swing check valves with bronze disc.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:
   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
   4. For Grooved-End Copper Tubing: Valve ends may be grooved.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 4 and Smaller:
   1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
   2. Ball Valves: Two piece, full port, bronze with bronze trim.
   3. Bronze Swing Check Valves: Class 125, bronze disc.
   4. Bronze Gate Valves: Class 125, NRS.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

D. Welding certificates.

1.6 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Cooper B-Line, Inc.
    b. Flex-Strut Inc.
    c. Hayden Corp.
    d. Powerstrut Corporation.
    e. Thomas & Betts Corporation.
    f. Unistrut Corporation.
    g. Wesanco, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Hot-dipped galvanized.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Low Type Pipe Stand(For single pipes ≤ 2 1/2" in diameter): Plastic base unit with galvanized steel rods and roller to support pipe, for roof installation without membrane penetration. Product equal to Portable Pipe Hanger #SS8-R.

C. High-Type, Single-Pipe Stand (For pipes > 2 1/2" in diameter):

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Plastic.
3. Vertical Members: Two HDG-channels.
4. Horizontal Member: HDG-steel channel.
5. Rod/Hanger: HDG continuous thread rod and clevis hanger.
6. Product equal to PPH #PS-1-2.

D. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: Plastic.
3. Vertical Members: Two or more HDG-steel channels.
4. Horizontal Member: HDG-steel channel.
5. Rod/Hanger: HDG continuous thread rod and clevis hangers, continuous thread rod.
6. Product equal to PPH #PSE-2-2.

E. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.9 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface with use of isolation pad. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.

G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.

H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

J. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

O. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use coated carbon-steel pipe hangers and supports metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.

F. Use padded hangers for piping that is subject to scratching.

G. Use thermal-hanger shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
7. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
8. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
9. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
10. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
11. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
12. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.

13. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve numbering scheme.

D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch, Stainless steel, 0.025-inch, or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/2 inch for name of units for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/2 inch for name of units for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/2 inch for name of units for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 1 1/2 inches for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Fiberboard or metal.
2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch, Stainless steel, 0.025-inch, or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.

2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

1. Domestic Water Piping:

a. Background Color: Green.
b. Letter Color: White.

2. Sanitary Waste Piping:

   a. Background Color: Black.
   b. Letter Color: White.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

   a. Cold Water: 1-1/2 inches round.
   b. Hot Water: 1-1/2 inches round.

2. Valve-Tag Color:

   a. Cold Water: Green.
   b. Hot Water: Green.

3. Letter Color:

   a. Cold Water: White.
   b. Hot Water: White.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

C. Qualification Data: For qualified Installer.

D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

E. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Pittsburgh Corning Corporation; Foamglas.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
5. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Aeroflex USA, Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. CertainTeed Corp.; SoftTouch Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Friendly Feel Duct Wrap.
    d. Manson Insulation Inc.; Alley Wrap.

e. Owens Corning; SOFTR All-Service Duct Wrap.

I. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000-Degree Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

J. Phenolic:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Kingspan Tarec Industrial Insulation NV; Koolphen K.
b. Resolco International BV; Insul-phen.

2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
5. Factory-Applied Jacket: ASJ. Requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Ramco Insulation, Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Ramco Insulation, Inc.; Thermokote V.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc.; 81-84.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc.; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc.; CP-127.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc.; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc.; CP-96.
b. Foster Brand, Specialty Construction Brands, Inc.; 81-33.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc.; CP-82.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc.; 85-20.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc.; CP-30.
b. Eagle Bridges - Marathon Industries; 501.
c. Foster Brand, Specialty Construction Brands, Inc.; 30-35.
d. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc.; Encacel.
b. Eagle Bridges - Marathon Industries; 570.
c. Foster Brand, Specialty Construction Brands, Inc.; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc.; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc.; 46-50.
d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass and Phenolic Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Brand, Specialty Construction Brands, Inc.; CP-76.
    b. Eagle Bridges - Marathon Industries; 405.
    c. Foster Brand, Specialty Construction Brands, Inc.; 30-45.
    d. Mon-Eco Industries, Inc.; 44-05.
    e. Pittsburgh Corning Corporation; Pittseal 444.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: Gray.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Brand, Specialty Construction Brands, Inc.; CP-76.
    b. Eagle Bridges - Marathon Industries; 405.
    c. Foster Brand, Specialty Construction Brands, Inc.; 95-44.
    d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc.; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc.; Chil-Glas Number 10.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc.; Metal Jacketing Systems.
b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. ABI, Ideal Tape Division; 428 AWF ASJ.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
   c. Compac Corporation; 104 and 105.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. ABI, Ideal Tape Division; 488 AWF.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
   c. Compac Corporation; 120.
   d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping and Seals.

2. Stainless Steel: ASTM A 167 or ASTM A 240 Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. C & F Wire.

2.11 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Engineered Brass Company.
    b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
    c. McGuire Manufacturing.
    d. Plumberex.
    e. Truebro; a brand of IPS Corporation.
    f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.10 FIELD-APPLIED JACKET INSTALLATION

A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.11 FINISHES

A. Do not field paint aluminum or stainless-steel jackets.

3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.13 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.14 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. All sizes: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
b. Phenolic: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. All sizes: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
b. Phenolic: 1 inch thick.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1/2 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

D. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.15 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:

1. All Pipe Sizes: Insulation shall be one of the following:
a. Phenolic: 2 inches thick.

3.16 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. Factory-applied ASJ.

D. Piping, Exposed:

1. Factory-applied ASJ.

3.17 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. Aluminum, Smooth 0.020 inch thick.

D. Piping, Exposed:

1. Aluminum, Smooth with Z-Shaped Locking Seam: 0.020 inch thick.

3.18 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220719

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
2. Encasement for piping.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Architect and/or Engineer no fewer than three days in advance of proposed interruption of water service.
2. Do not interrupt water service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

G. Copper Pressure-Seal-Joint Fittings:

1. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
2. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

H. Copper-Tube, Extruded-Tee Connections:

1. Description: Tee formed in copper tube according to ASTM F 2014.

I. Appurtenances for Grooved-End Copper Tubing:

1. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 copper tube or ASTM B 584 bronze castings.
2. Mechanical Couplings for Grooved-End Copper Tubing:

a. Copper-tube dimensions and design similar to AWWA C606.
b. Ferrous housing sections.
c. EPDM-rubber gaskets suitable for hot and cold water.
d. Bolts and nuts.
e. Minimum Pressure Rating: 300 psig.

2.3 PVC PIPE AND FITTINGS

A. PVC Pipe: ASTM D 1785, Schedule 40.

B. PVC Socket Fittings: ASTM D 2466 for Schedule 40.

C. PVC Schedule 80 Threaded Fittings: ASTM D 2464.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Solder Filler Metals: ASTM B 32, lead-free alloys.

C. Flux: ASTM B 813, water flushable.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

E. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.5 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: tube.

C. Color: Black or natural.

2.6 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

D. Plastic-to-Metal Transition Fittings:

1. Description:

a. PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.

b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Standard: ASSE 1079.
2. Pressure Rating: 150 psig.
3. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Standard: ASSE 1079.
2. Factory-fabricated, bolted, companion-flange assembly.
3. Pressure Rating: 150 psig.
4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Nonconducting materials for field assembly of companion flanges.
2. Pressure Rating: 150 psig.
3. Gasket: Neoprene or phenolic.
4. Bolt Sleeves: Phenolic or polyethylene.
5. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Standard: IAPMO PS 66.
2. Electroplated steel nipple complying with ASTM F 1545.
3. Pressure Rating and Temperature: 300 psig at 225 deg F.
4. End Connections: Male threaded or grooved.
5. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install domestic water piping level without pitch and plumb.

G. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

I. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

K. Install piping to permit valve servicing.

L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

M. Install piping free of sags and bends.

N. Install fittings for changes in direction and branch connections.

O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

P. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."

Q. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."

R. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

G. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

H. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

I. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

J. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. PVC Piping: Join according to ASTM D 2855.

K. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings.

3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.

d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be one of the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
2. PVC, Schedule 40; socket fittings; and solvent-cemented joints.

E. Under-building-slab, domestic water, building-service piping, NPS 4 and larger, shall be one of the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

F. Aboveground domestic water piping, NPS 4 and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and brazed joints.

G. Aboveground domestic water piping, NPS 5 and larger, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.

3.13 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use ball or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use ball valves for all piping.
3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Balancing valves.
4. Temperature-actuated, water mixing valves.
5. Strainers.
6. Outlet boxes.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water-hammer arresters.
11. Air vents.
12. Trap-seal primer device.
13. Flexible connectors.

B. Related Requirements:
1. Section 221116 "Domestic Water Piping" for water meters.
2. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
3. Section 224713 "Drinking Fountains" for water filters for water coolers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Standard: ASSE 1001.
2. Size: NPS 1/2 to NPS 3, as required to match connected piping.
3. Body: Bronze.
4. Inlet and Outlet Connections: Threaded.
5. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

1. Standard: ASSE 1011.
2. Body: Bronze, nonremovable, with manual drain.
3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
4. Finish: Rough bronze.

C. Pressure Vacuum Breakers

1. Standard: ASSE 1020.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 5 psig maximum, through middle third of flow range.
4. Accessories:

    a. Valves: Ball type, on inlet and outlet.

D. Laboratory-Faucet Vacuum Breakers:

1. Standard: ASSE 1035.
2. Size: NPS 1/2 or NPS 3/8 matching faucet size.
3. Body: Bronze.
4. End Connections: Threaded.
5. Finish: Chrome plated.

E. Spill-Resistant Vacuum Breakers:

    a.

2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Accessories:

a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 10 psig maximum, through middle third of flow range.
4. Body: Bronze for NPS 2 and smaller; steel with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Configuration: Designed for horizontal, straight-through or vertical flow.
7. Accessories:

    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Double-Check, Backflow-Prevention Assemblies:

1. Standard: ASSE 1015.
2. Operation: Continuous-pressure applications unless otherwise indicated.
3. Pressure Loss: 5 psig maximum, through middle third of flow range.
4. Body: Bronze for NPS 2 and smaller; steel with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Configuration: Designed for horizontal, straight-through flow.
7. Accessories:

    a. ValvesNPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. ValvesNPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

C. Hose-Connection Backflow Preventers:

1. Standard: ASSE 1052.
2. Operation: Up to 10-foot head of water back pressure.
3. Inlet Size: NPS 1/2 or NPS 3/4.
4. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
5. Capacity: At least 3-gpm flow.

2.5 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. ype: Ball valve with two readout ports and memory-setting indicator.
2. Body: Bronze.
3. Size: Same as connected piping, but not larger than NPS 2.
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

C. Memory-Stop Balancing Valves:

1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 2 or smaller.
4. Body: Copper alloy.
5. Port: full port.
6. Ball: Chrome-plated brass.
7. Seats and Seals: Replaceable.
8. End Connections: Solder joint or threaded.
9. Handle: Vinyl-covered steel with memory-setting device.

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Standard: ASSE 1070.
2. Pressure Rating: 125 psig.
3. Type: Thermostatically controlled, water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded union inlets and outlet.
6. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Valve Finish: Rough bronze.

2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:

    a. Strainers NPS 2 and Smaller: 0.062 inch.
    b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
    c. Strainers NPS 5 and Larger: 0.125 inch.

6. Drain: Factory-installed, hose-end drain valve.

2.8 OUTLET BOXES

A. Icemaker Outlet Boxes:

1. Mounting: Recessed.
2. Material and Finish Stainless-steel box and faceplate.
3. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
4. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.9 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include wall flange with each chrome- or nickel-plated hose bibb.

2.10 WALL HYDRANTS

A. Nonfreeze Wall Hydrant.

1. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
2. Pressure Rating: 125 psig.
3. Operation: Loose key.
4. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
5. Inlet: NPS 3/4 or NPS 1.
6. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
7. Box: Deep, flush mounted with cover.
8. Box and Cover Finish: Polished nickel bronze.
9. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
10. Nozzle and Wall-Plate Finish: Rough bronze.
11. Operating Keys(s): One with each wall hydrant.

2.11 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.

9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.12 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: Copper tube with piston.
3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.13 AIR VENTS

A. Bolted-Construction Automatic Air Vents.

1. Body: Bronze.
2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents.

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.14 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Standard: ASSE 1018.
2. Pressure Rating: 125 psig minimum.
3. Body: Bronze.
4. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.15 FLEXIBLE CONNECTORS

A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

C. Install water-control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

G. Install water-hammer arresters in water piping according to PDI-WH 201.

H. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

I. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.2 CONNECTIONS

A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Reduced-pressure-principle backflow preventers.
2. Double-check, backflow-prevention assemblies.
3. Reduced-pressure-detector, fire-protection, backflow-preventer assemblies.
4. Calibrated balancing valves.
5. Primary, thermostatic, water mixing valves.
6. Outlet boxes.
7. Supply-type, trap-seal primer valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test each backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Set field-adjustable flow set points of balancing valves.

B. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 221123 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Horizontally mounted, in-line, close-coupled centrifugal pumps.

1.3 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 HORIZONTALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
   1. Armstrong Pumps Inc.
   2. Bell & Gossett Domestic Pump; ITT Corporation.
   3. TACO Incorporated.

B. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted horizontal.

C. Pump Construction:

   1. Casing: Radially split with threaded companion-flange connections for pumps with NPS 2 pipe connections and flanged connections for pumps with NPS 2-1/2 pipe connections.
   2. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
   3. Shaft and Shaft Sleeve: Steel shaft with deflector, with copper-alloy shaft sleeve. Include water slinger on shaft between motor and seal.
   4. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
   5. Bearings: Oil-lubricated; bronze-journal or ball type.
   6. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.

D. Motor: Single speed, with grease-lubricated ball bearings; and resiliently or rigidly mounted to pump casing.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.3 CONTROLS

A. Timers: Electric, for control of hot-water circulation pump.

   1. Type: Programmable, seven-day clock with manual override on-off switch.
   2. Enclosure: NEMA 250, Type 1, suitable for wall mounting.
   3. Operation of Pump: On or off.

4. Transformer: Provide if required.
5. Programmable Sequence of Operation: Up to two on-off cycles each day for seven days.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install horizontally mounted, in-line, close-coupled centrifugal pumps with shaft(s) horizontal.

C. Install continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support pump weight.

1. Comply with requirements for vibration isolation devices specified in Section 220548 "Vibration Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
2. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

D. Install timers on equipment room wall in readily accessible area.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.

1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
   a. Horizontally mounted, in-line, close-coupled centrifugal pumps.
   b. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."

2. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties."
3. Install pressure gage at suction of each pump and pressure gage at discharge of each pump. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for

pressure gages and snubbers specified in Section 220519 "Meters and Gages for Plumbing Piping."

D. Connect timers to pumps that they control.

3.4 IDENTIFICATION

A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set timers, for automatic starting and stopping operation of pumps.
5. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.6 ADJUSTING

A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 221123

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

B. Related Sections:
1. Section 226600 "Chemical-Waste Systems for Laboratory and Healthcare Facilities" for chemical-waste and vent piping systems.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.
2. Waste, Force-Main Piping: 100 psig.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect and/or Engineer no fewer than three days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class(es).

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Heavy-Duty, Hubless-Piping Couplings:

1. Standards: ASTM C 1277 and ASTM C 1540.
2. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:

    a. Standard: ASTM C 1173.
    b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    c. Sleeve Materials:

        1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
        2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
        3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

4. Shielded, Nonpressure Transition Couplings:

    a. Standard: ASTM C 1460.
    b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

5. Pressure Transition Couplings:

    a. Standard: AWWA C219.
    b. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
    c. Center-Sleeve Material: Manufacturer's standard.

d. Gasket Material: Natural or synthetic rubber.
e. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:

a. Description:

1) Standard: ASSE 1079.
2) Pressure Rating: 150 psig.
3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:

a. Description:

1) Standard: ASSE 1079.
2) Factory-fabricated, bolted, companion-flange assembly.
3) Pressure Rating: 150 psig.
4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

a. Description:

1) Nonconducting materials for field assembly of companion flanges.
2) Pressure Rating: 150 psig.
3) Gasket: Neoprene or phenolic.
4) Bolt Sleeves: Phenolic or polyethylene.
5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

a. Description:

1) Standard: IAPMO PS 66
2) Electroplated steel nipple.
3) Pressure Rating: 300 psig at 225 deg F.
4) End Connections: Male threaded or grooved.
5) Lining: Inert and noncorrosive, propylene.

2.6 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 674 or AWWA C105/A 21.5.

B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.

C. Form: Tube.

D. Color: Black.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

O. Install aboveground PVC piping according to ASTM D 2665.

P. Install underground PVC piping according to ASTM D 2321.

Q. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

R. Plumbing Specialties:
1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

W. For PVC piping installed in a return air plenum, contractor shall wrap pipe in an approved fire wrap insulation.

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

F. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

G. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:

   a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
   b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Section 220523 "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
2. Install gate or full-port ball valve for piping NPS 2 and smaller.
3. Install gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

H. Install supports for vertical PVC piping every 48 inches.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.11 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings heavy-duty hubless-piping couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Aboveground, vent piping shall be any of the following:
   1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
   2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
   3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
   1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
   2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Cleanouts.
   2. Floor drains.
   3. Roof flashing assemblies.
   4. Through-penetration firestop assemblies.
   5. Miscellaneous sanitary drainage piping specialties.
   6. Flashing materials.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete.

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Metal Floor Cleanouts
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.
    b. Smith, Jay R. Mfg. Co..
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing.

2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Heavy-duty, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Threaded.
8. Closure: Cast-iron plug.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Painted cast iron.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

B. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.

b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, stainless-steel cover plate with screw.
8. Wall Access: Round stainless-steel wall-installation frame and cover.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing.

2. Refer to plumbing fixture schedule.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

B. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.
2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
2. Size: Same as connected soil, waste, or vent stack.
3. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
4. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
5. Special Coating: Corrosion resistant on interior of fittings.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

    a. NPS 2: 4-inch minimum water seal.
    b. NPS 2-1/2 and Larger: 5-inch minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

D. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

H. Expansion Joints:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.6 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft, 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft..
2. Vent Pipe Flashing: 8 oz./sq. ft..

C. Zinc-Coated Steel Sheet: ASTM A 653, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting: Install above grade grease interceptors and solids interceptors on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases specified in Section 033000 "Cast-in-Place Concrete."

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct bases to withstand, without damage to equipment, seismic force required by code.
3. Construct concrete bases 4 inches high and extend base not less than 6 inches in all directions beyond the maximum dimensions of interceptors, unless otherwise indicated.
4. Minimum Compressive Strength: 4000 psi at 28 days.

5. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
6. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
7. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
8. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

H. Assemble open drain fittings and install with top of hub 1 inch above floor.

I. Install deep-seal traps on floor drains and other waste outlets, if indicated.

J. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.

2. Size: Same as floor drain inlet.

K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

L. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

M. Install vent caps on each vent pipe passing through roof.

N. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

O. Install wood-blocking reinforcement for wall-mounting-type specialties.

P. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 22 33 00 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Electric, storage-type, water heaters.
2. Domestic-water heater accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of commercial, electric, domestic-water heater, from manufacturer.

B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

C. Source quality-control reports.

D. Field quality-control reports.

E. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

C. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Warranty on all electrical components against defects in workmanship and material for a period of one (1) year from date of start-up, and the heating chamber for a full five (5) years from date of start-up, provided that the unit is started within three (3) months of date of shipment.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, STORAGE-TYPE DOMESTIC-WATER HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Water Heaters.
2. Rheem Manufacturing Company.
3. Smith, A. O. Water Products.
4. Lochinvar

B. Standard: UL 1453.
1. The tank shall be all welded steel commercial construction designed for 150psi working pressure. The tank shall be designed and fabricated with non-ferrous copper-silicon threaded tappings and non-ferrous inlet and outlet piping for maximum corrosion resistance. Steel tank tappings will not be acceptable. Pressure Rating: 150 psig.
2. Interior Finish: The tank is to be lined with seamless Hydrastone Cement to a minimum thickness of 1/2" on 100% of all interior tank surfaces and shall not require any type of anodic protection.

C. Special Requirements: NSF 5 construction.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:

1. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

2. Construction:

a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
c. Air-Charging Valve: Factory installed.

B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.

D. Heat-Trap Fittings: ASHRAE 90.2.
1.

E. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig- (172.5-kPa-) maximum outlet pressure unless otherwise indicated.

F. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

G. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.

H. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

I. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

J. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches (457 mm) above the floor.

K. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.3 SOURCE QUALITY CONTROL

A. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."

B. Install combination temperature-and-pressure relief valves in water piping for electric, water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

C. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

D. Install thermometers on inlet and outlet piping of electric, water heaters.

E. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for outlet pressure of 25 psig. Comply with requirements for pressure-reducing valves and water hammer arresters specified in Section 221119 "Domestic Water Piping Specialties."

F. Fill electric, domestic-water heaters with water.

G. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain, electric, domestic-water heaters.

END OF SECTION 22 33 00

SECTION 224213.13 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Water closets.
2. Flushometer valves.
3. Toilet seats.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

A. Water Closets: Floor mounted, bottom outlet, top spud.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Standard America.
    b. Kohler Co.
    c. TOTO USA, INC.
    d. Zurn Industries, Incl

2. Bowl:

    a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
    b. Material: Vitreous china.
    c. Type: Siphon jet.
    d. Style: Flushometer valve.
    e. Rim Contour: Elongated.
    f. Spud Size and Location: NPS 1-1/2; top.
    g. Color: White, UNO.

3. Bowl-to-Drain Connecting Fitting: ASTM A 1045.

4. Refer to Plumbing Schedule for Specification Standards.

2.2 FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Sloan Valve Company.
    b. Zurn Industries, LLC.
    c. Kohler Co.

2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Minimum Inlet: NPS 1.
9. Minimum Outlet: NPS 1-1/4.

2.3 TOILET SEATS

A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Standard America.
    b. Bemis Manufacturing Company.
    c. Church Seats.
    d. Kohler Co.

e. Olsonite Seat Co.

2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: To match bowl.
6. Hinge: Self-sustaining.
7. Hinge Material: Noncorroding metal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.

3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 224216.13 - COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Lavatories.
2. Faucets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory: Vitreous china, wall mounted, with back.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Standard America.
    b. TOTO USA, INC.
    c. Kohler Co.
    d. Zurn Ind. Inc.

2. Fixture:

    a. Standard: ASME A112.19.2/CSA B45.1.
    b. Type: For wall hanging.
    c. Mounting Material: Chair carrier.
    d. Refer to Plumbing fixture schedule for additional information.

3. Support: ASME A112.6.1M, Type II concealed-arm lavatory carrier.

2.2 SOLID-BRASS, MANUALLY OPERATED FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Lavatory Faucets: Manual-type, commercial, solid-brass valve.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

    a. American Standard America.
    b. Bradley Corporation.
    c. Chicago Faucets.
    d. Elkay Manufacturing Co.
    e. T & S Brass and Bronze Works, Inc.
    f. Kohler Co.

2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
4. Body Material: Commercial, solid brass.
5. Refer to plumbing schedule for additional information.

2.3 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Wheel handle.

F. Risers:

1. NPS 1/2.
2. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

2.4 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2 by NPS 1-1/4.
2. Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch- thick brass tube to wall; and chrome-plated, brass or steel wall flange.
3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch- thick stainless-steel tube to wall; and stainless-steel wall flange.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

B. Examine counters and walls for suitable conditions where lavatories will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install lavatories level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

SECTION 224216.16 - COMMERCIAL SINKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Service basins.
2. Utility sinks.
3. Sink faucets.
4. Supply fittings.
5. Waste fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sinks to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 SERVICE BASINS

A. Service Basins: Terrazzo, floor mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Acorn Engineering Company.
    b. Crane Plumbing, L.L.C.
    c. Florestone Products Co., Inc.
    d. Stern-Williams Co., Inc.

2. Fixture:

    a. Standard: IAPMO PS 99.
    b. Shape: Five sided.
    c. Nominal Size: 24 by 24 inches.
    d. Height: 12 inches with dropped front.
    e. Tiling Flange: On two sides.
    f. Rim Guard: On all top surfaces.
    g. Drain: Grid with NPS 3 outlet.

3. Mounting: On floor and flush to wall.
4. Refer to plumbing schedule for specification standards.

2.2 UTILITY SINKS

A. Utility Sinks: Stainless steel, counter mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Elkay Manufacturing Co.
    b. Kohler Co.
    c. Just Manufacturing.

2. Fixture:

    a. Standard: ASME A112.19.3/CSA B45.4.
    b. Type: Ledge back.

3. Supply Fittings:

    a. Standard: ASME A112.18.1/CSA B125.1.
    b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.

        1) Operation: Wheel handle.
        2) Risers: NPS 1/2, ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

4. Waste Fittings:

    a. Standard: ASME A112.18.2/CSA B125.2.
    b. Trap(s):

        1) Size: NPS 2.
        2) Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.
        3) Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

5. Mounting: On counter with sealant.

6. Refer to Plumbing Schedule for Specifications Standards.

2.3 SINK FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets: Manual type, two-lever-handle mixing valve.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Standard America.
    b. Bradley Corporation.
    c. Chicago Faucets.
    d. Elkay Manufacturing Co.
    e. T & S Brass and Bronze Works, Inc.
    f. Kohler Co.

2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
4. Body Material: Commercial, solid brass.
5. Finish: Chrome plated.
6. Refer to Plumbing Schedule for Specification Standards.

2.4 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Wheel handle.

F. Risers:

1. NPS 1/2
2. ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

2.5 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2.
2. Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.
3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

2.6 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sinks level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-hung sinks.

C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.

D. Set floor-mounted sinks in leveling bed of cement grout.

E. Install water-supply piping with stop on each supply to each sink faucet.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

SECTION 224223 - COMMERCIAL SHOWERS, RECEPTORS, AND BASINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Shower faucets.
   2. Grout.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for showers and basins.
   2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For shower faucets to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

   1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
   2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 SHOWER FAUCETS

A. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for shower materials that will be in contact with potable water.

B. Shower Faucets:

1. Manufacturers: Subject to compliance with requirements provide products by one of the following

    a. American Standard America.
    b. Chicago Faucets.
    c. Kohler Co.
    d. Moen Incorporated.
    e. Powers; a division of Watts Water Technologies, Inc.

2. Description: Single-handle, mixing valve with hot- and cold-water indicators; check stops; and shower head. Refer to plumbing fixture schedule.

2.2 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before shower installation.

B. Examine walls and floors for suitable conditions where showers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble shower components according to manufacturers' written instructions.

B. Install showers level and plumb according to roughing-in drawings.

C. Install water-supply piping with stop on each supply to each shower faucet.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with shower. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

D. Install shower flow-control fittings with specified maximum flow rates in shower arms.

E. Set shower receptors and basins in leveling bed of cement grout.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheons requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

G. Seal joints between showers and floors and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with traps and soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust showers and controls. Replace damaged and malfunctioning showers, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of showers and basins, inspect and repair damaged finishes.

B. Clean showers and basins, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed fixtures and fittings.

D. Do not allow use of showers and basins for temporary facilities unless approved in writing by Owner.

END OF SECTION 224223

SECTION 224500 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Combination units.
   2. Water-tempering equipment.

1.3 DEFINITIONS

A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.

C. Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid-solution supply.

D. Tepid: Moderately warm.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.

D. Regulatory Requirements: Comply with requirements in ICC/ANSI A117.1, "Accessible and Usable Buildings and Facilities" Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

PART 2 - PRODUCTS

2.1 COMBINATION UNITS

A. Accessible, Plumbed Emergency Shower with Eyewash Combination Units:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Acorn Safety; a division of Acorn Engineering Company.
    b. Bradley Corporation.
    c. Encon Safety Products.
    d. Guardian Equipment Co.
    e. Haws Corporation.
    f. Sellstrom Manufacturing Company.
    g. Speakman Company.
    h. WaterSaver Faucet Co.

2. Piping:

    a. Material: Galvanized steel.
    b. Unit Supply: NPS 1-1/4 minimum.
    c. Unit Drain: Outlet at back or side near bottom.

3. Shower:

    a. Capacity: Not less than 20 gpm for at least 15 minutes.
    b. Supply Piping: NPS 1 with flow regulator and stay-open control valve.
    c. Control-Valve Actuator: Pull rod.
    d. Shower Head: 8-inch minimum diameter, stainless steel or plastic.
    e. Mounting: Pedestal.

4. Eyewash Unit:

    a. Capacity: Not less than 0.4 gpm for at least 15 minutes.
    b. Supply Piping: NPS 1/2 with flow regulator and stay-open control valve.
    c. Control-Valve Actuator: Paddle.
    d. Spray-Head Assembly: Two receptor-mounted spray heads.
    e. Receptor: stainless-steel or Plastic bowl.

f. Mounting: Attached shower pedestal.
g. Drench-Hose Option: May be provided instead of eyewash unit.

1) Capacity: Not less than 0.4 gpm for at least 15 minutes.
2) Drench Hose: Hand-held spray head with squeeze-handle actuator and hose.
3) Mounting: Bracket on shower pedestal.

2.2 SOURCE QUALITY CONTROL

A. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."

1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency equipment.
2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.

E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in Section 221116 "Domestic Water Piping."

F. Install trap and waste piping on drain outlet of emergency equipment receptors that are indicated to be directly connected to drainage system. Comply with requirements for waste piping specified in Section 221316 "Sanitary Waste and Vent Piping."

G. Install indirect waste piping on drain outlet of emergency equipment receptors that are indicated to be indirectly connected to drainage system. Comply with requirements for waste piping specified in Section 221316 "Sanitary Waste and Vent Piping."

H. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 CONNECTIONS

A. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment. Comply with requirements for cold-water piping specified in Section 221116 "Domestic Water Piping."

B. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary waste or storm drainage piping.

C. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

3.4 FIELD QUALITY CONTROL

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Emergency plumbing fixtures will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION 224500

SECTION 224713 - DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes drinking fountains and related components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of drinking fountain.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include operating characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For drinking fountains to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

A. Drinking Fountains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Elkay Manufacturing Company.
b. Haws Corporation.
c. Halsey Taylor.

2. Refer to Plumbing Schedule for Specification Standards.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.

B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."

D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball, gate, or globe shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

3.5 CLEANING

A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224713

SECTION 226600 - CHEMICAL-WASTE SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall piping.
2. Piping specialties.
3. Neutralization tanks.
4. Manholes.

1.3 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. FPM: Vinylidene fluoride-hexafluoro propylene copolymer rubber.

1.4 PERFORMANCE REQUIREMENTS

A. Single-Wall Piping Pressure Rating: 10 feet head of water.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.6 INFORMATIONAL SUBMITTALS

A. Profile Drawings for Outdoor Underground Piping: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate underground structures and pipes. Show types, sizes, materials, and elevations of other utilities crossing system piping.

B. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewerage system piping. Indicate interface and spatial relationship between piping and proximate structures.

C. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For chemical-waste specialties and neutralization tanks, to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Neutralization-Tank Limestone: Equal to 200 percent of amount required for each tank sump initial charge. Furnish limestone in 50-lb bags.

1.9 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 70, "National Electrical Code."

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store piping and specialties with sealing plugs in ends or with end protection.

B. Do not store plastic pipe or fittings in direct sunlight.

C. Protect pipe, fittings, and seals from dirt and damage.

1.11 PROJECT CONDITIONS

A. Interruption of Existing Chemical-Waste Service: Do not interrupt chemical-waste service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary chemical-waste service according to requirements indicated:

1. Notify Architect no fewer than five days in advance of proposed interruption of chemical-waste service.
2. Do not proceed with interruption of chemical-waste service without Architect's written permission.

1.12 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 SINGLE-WALL PIPE AND FITTINGS

A. PVDF Drainage Pipe and Fittings: ASTM F 1673, Schedule 40, pipe and drainage-pattern fittings. Include fittings with fusion- and mechanical-joint ends.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Orion Fittings.
    b. Zurn; Chemical Drainage Systems.

B. Adapters and Transition Fittings: Assemblies with combination of clamps, couplings, adapters, and gaskets; compatible with piping and system liquid; made for joining different piping materials.

2.2 JOINING MATERIALS

A. Couplings: Assemblies with combination of clamps, gaskets, sleeves, and threaded or flanged parts; compatible with piping and system liquid; and made by piping manufacturer for joining system piping.

B. Adapters and Transition Fittings: Assemblies with combination of clamps, couplings, adapters, gaskets, and threaded or flanged parts; compatible with piping and system liquid; and made for joining different piping materials.

C. Flanges: Assemblies of companion flanges and gaskets complying with ASME B16.21 and compatible with system liquid, and bolts and nuts.

2.3 PIPING SPECIALTIES

A. Corrosion-Resistant Traps:

1. Type: P-trap or drum trap.
2. Size: NPS 1-1/2 or NPS 2, as required to match connected piping.
3.
4. PVDF: ASTM D 3222, with mechanical-joint pipe connections.

B. PP Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Orion Fittings.
    b. Zurn: Chemical Drainage Systems.

2. Body: With 7- to 9-inch top diameter, with flashing flange and weep holes; and with flashing clamp and trap-primer connection.
3. Outlet: Bottom, to match connecting pipe, with NPS 2, NPS 3, NPS 4, or NPS 6 outlet as indicated.

C. PP Sink Outlets:

1. Description: NPS 1-1/2, with clamping device, stopper, and 7-inch- high overflow fitting.

2.4 NEUTRALIZATION TANKS

A. Plastic Neutralization Tanks:

1. Description: Corrosion-resistant plastic materials; with removable, gastight cover; interior, sidewall, dip-tube inlet; outlet; vent; and threaded or flanged, sidewall pipe connections.

a. Material: ASTM D 4101, PP.
b. Tank Capacity: As scheduled.
c. Dip Tube: On outlet pipe instead of inlet pipe.
d. Extension: PP.
e. Traffic Cover: As scheduled.
f. Limestone: Chips or lumps, with more than 90 percent calcium carbonate content and 1- to 3-inch diameter.
g. Dolomitic Limestone: Chips or lumps, with more than 90 percent combined magnesium carbonate and calcium carbonate content and 1- to 3-inch diameter.

2.5 MANHOLES

A. Description: ASTM F 1759, fabricated from PE components. Include bottom, sidewalls, and top sections; corrosion-resistant, manhole frame and cover; fusion or other watertight joints; and design to prohibit flotation.

1. Construction: Single wall.
2. Bottom: Channeled.
3. Connections: Inlets and outlet matching or suitable for piping.
4. Steps: Manufacturer's standard, fusion welded to sidewall. Omit steps for manholes less than 60 inches deep.
5. Top: Include 24-inch- nominal-diameter frame and cover.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 CONCRETE BASES

A. Anchor neutralization tanks to concrete bases.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 19-inch centers around full perimeter of base.
2. For installed equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
6. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete."
7. Comply with requirements in Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete materials and placement.

3.3 PIPING INSTALLATION

A. Chemical-Waste Sewerage Outside the Building:

1. Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground chemical-waste sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
2. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
3. Install manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
4. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
5. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or combination of both.
6. Install drainage piping pitched down in direction of flow, at minimum slope of 2 percent, unless otherwise indicated.
7. Install drainage piping with 36-inch minimum cover.
8. Install PP drainage piping according to ASTM D 2321 and ASTM F 1668.
9. Install PVDF drainage piping according to ASTM D 2321 and ASTM F 1668.
10. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

B. Chemical-Waste Piping Inside the Building:

1. Install piping next to equipment, accessories, and specialties to allow service and maintenance.
2. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.
3. Flanges may be used on aboveground piping unless otherwise indicated.
4. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
5. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
6. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
7. Install piping at indicated slopes.
8. Install piping free of sags and bends.
9. Install fittings for changes in direction and branch connections.

10. Verify final equipment locations for roughing-in.
11. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
12. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
13. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.4 PIPING SPECIALTY INSTALLATION

A. Embed floor drains in 4-inch minimum depth of concrete around bottom and sides. Comply with requirements in Section 033000 "Cast-in-Place Concrete" for concrete.

B. Fasten grates to drains if indicated.

C. Set floor drains with tops flush with pavement surface.

D. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use fittings of same material as sewer pipe at branches for cleanouts and riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in pipe.

1. Set cleanout bodies in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade. Set cleanout plugs in concrete pavement with tops flush with pavement surface. Comply with requirements in Section 033000 "Cast-in-Place Concrete" for formwork, reinforcement, and concrete requirements.

E. Install backwater valves in horizontal position. Include riser to cleanout at grade.

3.5 JOINT CONSTRUCTION

A. Chemical-Waste Sewerage Outside the Building:

1. Plastic-Piping, Electrofusion Joints: Make polypropylene drainage-piping joints according to ASTM F 1290.
2. Join dissimilar pipe materials with adapters compatible with pipe materials being joined.

B. Chemical-Waste Piping Inside the Building:

1. Plastic-Piping Electrofusion Joints: Make polypropylene drainage-piping joints according to ASTM F 1290.
2. Dissimilar-Material Piping Joints: Make joints using adapters compatible with both system materials.

3.6 HANGER AND SUPPORT INSTALLATION

A. Pipe sizes in this article refer to aboveground, single-wall piping.

B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:

1. Vertical Piping: MSS Type 8 or MSS Type 42, riser clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for installation of supports.

D. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

E. Support vertical piping and tubing at base and at each floor.

F. Rod diameter may be reduced 1 size for double-rod hangers, to minimum of 3/8 inch.

G. Install vinyl-coated hangers for PVDF piping with the following maximum horizontal spacing and minimum rod diameters:

1. All Sizes: Install continuous support for piping with liquid waste at temperatures above 140 deg F.
2. NPS 1/2 and Smaller: 30 inches with 3/8-inch rod.
3. NPS 3/4 to NPS 1-1/2: 36 inches with 3/8-inch rod.
4. NPS 2: 36 inches with 3/8-inch rod.
5. NPS 2-1/2 and NPS 3: 42 inches with 1/2-inch rod.
6. NPS 4: 48 inches with 5/8-inch rod.

H. Install supports for vertical PVDF piping NPS 1-1/2 every 48 inches and NPS 2 and larger every 72 inches.

I. Support piping and tubing not listed above according to MSS SP-69.

3.7 NEUTRALIZATION TANK INSTALLATION

A. Install exterior neutralization tanks, complete with appurtenances indicated.

1. Set tops of tank covers flush with finished surface where covers occur in pavements. Set covers 3 inches above finished surface elsewhere unless otherwise indicated.
2. Include initial fill of limestone for neutralization tanks.

B. Install interior neutralization tanks on smooth and level concrete base. Include full initial charge of limestone.

3.8 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated. Comply with requirements in Section 221313 "Facility Sanitary Sewers."

B. Set tops of manhole frames and covers flush with finished surface where manholes occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

3.9 CONCRETE PLACEMENT

A. Comply with requirements in Section 033000 "Cast-in-Place Concrete" for concrete supports.

B. Place cast-in-place concrete according to ACI 318/318R.

3.10 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Make connections to existing piping so finished Work complies as nearly as practical with requirements specified for new Work.

C. Use commercially manufactured wye fittings for sewerage piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

D. Protect existing piping to prevent concrete or debris from entering while making connections. Remove debris or other extraneous material that may accumulate.

E. Install piping adjacent to equipment to allow service and maintenance.

3.11 LABELING AND IDENTIFICATION

A. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for labeling of equipment and piping.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.12 FIELD QUALITY CONTROL

A. Inspect interior of sewerage piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place and again at completion of Project.

1. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between inspection points.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
c. Crushed, broken, cracked, or otherwise damaged piping.
d. Hydrostatic Tests for Drainage Piping:

1) Allowable leakage is a maximum of 50 gal./inch of nominal pipe size per mile of pipe, during 24-hour period.
2) Close openings in system and fill with water.
3) Purge air and refill with water.
4) Disconnect water supply.
5) Test and inspect joints for leaks.

e. Air Tests for Drainage Piping: Comply with UNI-B-6.

2. Leaks and loss in test pressure constitute defects that must be repaired.
3. Submit separate reports for each test.

B. Replace leaking sewerage piping using new materials, and repeat testing until leakage is within allowances specified.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

E. Chemical-waste piping will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.13 CLEANING

A. Use procedures prescribed by authorities having jurisdiction or, if not prescribed, use procedures described below:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Clean piping by flushing with potable water.

3.14 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below unless otherwise indicated.

B. Single-Wall, Chemical-Waste Sewerage Piping: Use any of the following piping materials for each size range:
1. NPS 1-1/2 to NPS 4: PVDF drainage pipe and fittings and electrofusion joints.

C. Aboveground Chemical-Waste Piping: Use any of the following piping materials for each size range:
1. NPS 1-1/2 to NPS 4: PVDF drainage piping and electrofusion or mechanical joints.

D. Under Slab-on-Grade, Indoor, Chemical-Waste Piping: Use any of the following piping materials for each size range:
1. NPS 1-1/2 to NPS 4: PVDF drainage piping and electrofusion joints.

END OF SECTION 226600

SECTION 23 05 00

MECHANICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL

A. Drawings and general previsions apply to this Section.

B. Examine all plans and specifications, visit the site(s) of the proposed project, and become fully informed as to the extent and character of the work required.

1.2 REQUIRED STANDARDS

A. Laws and Regulations of the State of Texas.

B. Local county and city codes and ordinances.

1.3 COORDINATION

A. Coordinate work under this Division to avoid conflicts and to attain satisfactory and complementary systems.

B. Coordinate work under this Division with work under other Divisions to avoid conflicts and to allow for adequate installation, maintenance, and operating space. Obtain the Architect's approval for penetrations of other parts of the Work prior to effecting them.

C. In resolving pipe, duct and conduit coordination, meet all requirements and be guided by these general orders of precedence:

1. Accommodate gravity flow lines with required slopes before other lines.
2. Accommodate lines with specific slope requirements (i.e., steam and refrigerant gas) before other lines.
3. Accommodate work with a required reference elevation before other work.
4. Accommodate mains before branches.
5. Accommodate pipe and duct before conduit.
6. Accommodate large lines before small lines.
7. Accommodate pipe before duct.
8. Accommodate high-pressure and high-velocity duct before low-pressure and low-velocity duct.

D. Coordination of the work must occur between all project contractors and the requirements of access and priority shall be maintained regardless of the equipment installed "first."In resolving pipe, duct, and conduit coordination, meet all requirements and be guided by these general orders of precedence.

1.4 DEFINITIONS

Specific meanings used in Division 23 (variant forms are inferred):

A. Work: This project, or the reference part.

B. Provide:

1. Furnish and install, complete with necessary appurtenances.
2. "Provide" is implied throughout this Division unless language is specific.

C. Required: Required by the contract Documents.

D. Necessary: Necessary in order to obtain a finished system in satisfactory operating condition, and meeting all requirements.

E. Furnish: Procure and deliver, ready for installation, necessary and/or required.

F. Install: Receive, place securely, ready for connection to work specified elsewhere, and bring into satisfactory operating condition, as necessary and/or required.

G. Connect: Connect properly to mechanical work. This includes non-physical "connections" such as indirect waste drains.

H. Architect, Project Architect or Architect/Engineer Team.

1.5 SCOPE OF WORK

A. The work under this Division includes providing complete mechanical systems for the project.

B. All items of labor, material or equipment not required in detail by the specifications or plans, but incidental to, or necessary for the complete installation and proper operation of all phases of work described herein, or reasonably implied in connection therewith, shall be furnished as if called for in detail by the Contract Documents.

1.6 WORKMANSHIP

A. All labor shall be performed in a workmanlike manner by mechanics skilled in their particular trades. All installations shall be complete in both effectiveness and appearance whether finally enclosed or left exposed. The architect reserves the right to direct the removal or

replacement of any item which in his opinion shall not present a reasonable neat or workmanlike appearance, providing that same can be properly installed in an orderly way.

1.7 MANUFACTURER'S INSTRUCTIONS

A. Obtain written recommendations and installation and start-up instructions from material vendors and comply, unless otherwise required. Bring discrepancies between these instructions and project requirements to the attention of the Architect, and resolve prior to construction. Provide signed inspection report by manufacture's representative at system start-up to verify construction and warrantability.

1.8 OWNER'S INSTRUCTIONS

A. Provide training to the Owner in the operation of all systems and equipment. All such training shall be videotaped, and the Owner shall be provided two copies of this material in a USB 3.0 flash drive.

1.9 PERMITS AND FEES

A. Permits: Obtain special permits necessary for this portion of the Work.

B. Fees: Pay any fees associated with permits, required inspections, and permanent utility connections to this part of the work.

1.10 LICENSES

A. Work under this Division shall be performed by organizations and individuals holding a current license to perform such type of work by the authority having jurisdiction. "License" in this sense means any process, regardless of its appellation, which is normally mandated by the authority in order to perform such type of work within its jurisdiction.

B. In the event that the licensed organization loses its license or is unable to obtain one, or the licensed individual performing the work becomes unlicensed or deports the organization, notify Architect immediately in writing.

1.11 UTILITY COORDINATION

A. Permanent: In general, provide all ancillary work necessary to obtain utility connections. Pay connection fees. Arrange for connection in a timely manner. Coordinate time and arrangement of other work with the serving utility, and comply with utility standards.

B. Temporary: Refer to Division 1.

1.12 LISTING AND LABELING

Materials required to be listed shall be listed and labeled for the particular service if a listing is available. Obtain and comply with the terms of listings. Listed material include.

A. NSF: Potable water and sanitary waste systems components.

B. UL: Electrical materials.

C. AMCA: Air moving devices and related accessory items.

D. ARI: HVAC equipment.

E. FM or UL: Hazardous fluid and fire protection system components.

F. FIA, FM or AGA: Fuel gas system components.

1.13 MATERIALS AND EQUIPMENT

A. All materials and equipment shall be new. Products shall be currently manufactured.

B. All materials and equipment shall be clearly marked, stamped or labeled for identification. Do not obscure nameplates. Where manufactures nameplates do not meet the requirements of the mechanical identification specification provide nameplates in accordance with the specification.

C. All products of similar type shall be provided by a single manufacturer throughout the project.

1.14 SUBMITTALS AND REVIEW

A. Submittals shall be furnished in a USB 3.0 flash drive as one complete e-book in .PDF format organized with dividers indicating each specification section. All submitted data shall reference specification sections. Piece-mail electronic submittals via e-mail and/or hard copy submittals shall not be acceptable.

B. Contractor shall furnish to the Architect, within a reasonable time after award of contract, and prior to commencing any work, complete brochures in quadruplicate (plus quantity required by the Contractor) of all materials and equipment which the contractor proposes to furnish on the project. Data shall include descriptive literature, performance data, diagrams, capacity information, etc., to substantiate that proposed equipment will meet all of the requirements of the plans and specifications.

C. All data must be checked and any required changes noted thereon by the contractor, signed and dated prior to furnishing same to the Architect for approval. Contractor's attention is directed that it is mandatory that they thoroughly review data prior to furnishing same to assure that equipment is in accordance with plans and specifications and to assure prompt return of the data.

D. Deviations: Specifically call to the attention of the Architect every proposed deviation from the Contract Document requirements. Failure to identify deviations as such constitutes a representation that all requirements are not met.

E. Review: Review of submittals shall not be construed as releasing the Contractor from responsibility, but rather as a means to facilitate coordination of the work and the proper selection and installation of the products. All work shall be subject to final acceptance by the Architect at the completion of the project.

F. If above information is not provided complete as specified above and within the allocated time, all equipment shall be furnished exactly as specified without any substitutions.

1.15 SUBSTITUTIONS

A. Refer to the Conditions of the Contract.

B. Where one vendor is indicated for a product, it is to establish a level of quality and performance; provide a product equal to that product in all respects from a vendor of equivalent performance.

C. Where multiple vendors are indicated for a product, any of those vendors meeting the requirements may be submitted.

D. Some product specifications in this Division are of the Acceptable Manufacturer type. Vendors listed as Acceptable Manufacturers are acceptable as vendors. However, the product submitted is subject to review as being fully equivalent in detail to the basis of design.

E. Where multiple vendors are listed with product model numbers, each model and vendor is acceptable, provide all requirements are met. Model numbers are indicated to the extent believe necessary to identify a type and are not necessary completely.

F. The architectural/engineering team has designed the facility using requirements of the Basis of Design equipment. Any substitutions from the basis of design, which will require additional A/E design and/or coordination, shall include the cost of necessary redesign by professionals licensed in the respective disciplines and the approval of the professional of record.

G. Additional submittal reviews beyond the first two (2) shall incur a cost paid by check to Sigma HN Engineers, PLLC. Payment shall be due upon receipt of submittal review comments from the licensed professional engineer. Cost for additional submittal reviews beyond the first two shall be on an hourly basis at $250/hour.

1.16 DRAWINGS AND SPECIFICATIONS

A. These specifications are accompanied by Drawings. The Drawings and Specifications are complementary each to the other, and what is called for by one shall be as binding as if called for by both.

B. The Drawings are generally diagrammatic. Lay out work at the site to conform to existing conditions; architectural, structural, mechanical, and electrical conditions; to avoid all obstructions; and to conform to details of installation as required. Provide an integrated satisfactorily operating installation. All necessary offsets in piping, fittings, duct, etc., required to avoid interferences between piping, equipment, architectural, and structural elements shall be provided by the Contractor. Provide all necessary routing and offsets to avoid conflict.

C. Verify and arrange that sufficient space is provided for the installation of proposed products and that adequate access will exist for service and maintenance of equipment. For this work, adequate access shall be defined as meaning that service personnel can access and maintain a piece of equipment without having to alter permanent construction. Further, for equipment located above ceilings, access shall be available within 3 feet of ceiling opening or lay-in ceiling.

1.17 COMPLEMENTARY DOCUMENTS

A. Contract documents are complementary; requirements are not necessarily repetitively stated at each possible subject; consider that a requirement applies wherever applicable.

B. In the event of conflicting requirements in different parts of the Documents, the more expensive shall be presumed to apply, unless the Architect clarifies the requirement in a less expensive manner and waives the more expensive requirement in writing.

Since codes and standards are incorporated by reference, a particular conflict may appear in that a reference may use language that implies that a particular requirement in the Construction Documents is waived under the reference. This is not the case, unless specifically so clarified by the Architect. Generally, the specific Drawings and Specifications take precedence over waivers in multi-purpose reference documents.

C. Because of licensure and workmanship requirements, persons performing the work are presumed to be familiar with applicable codes, ordinances, laws, regulations and standards. Therefore, details of materials, methods, arrangements and size contained in such publications are not necessarily replicated in the Contract Documents. This in no way deletes the requirement of the Contractor to comply. In the event of an apparent conflict between such publications and the Contract Documents, request clarification from the Architect prior to construction.

1.18 REGULATORY MEETINGS

A. Comply with laws, rules and regulations, permit requirements, and ordinances. It is intended that the work of the Division be estimated and performed under the supervision of licensed master craftsman who are familiar with these requirements, whether illustrated or specifically detailed in the particular Contract Documents of this project or not. Therefore, regulatory requirements may not be so illustrated or detailed.

1.19 PROTECTION

A. All work, equipment and materials shall be protected at all times to prevent damage or breakage either in transit, storage, installation or testing. All openings shall be closed with caps or plugs during installation. All materials and equipment shall be covered and protected against dirt, water, chemicals or mechanical injury.

1.20 CUTTING AND PATCHING

A. The work shall be carefully laid out in advance and the exact size and locations of openings arranged.

1.21 VIBRATION AND NOISE

A. Objectionable vibration and/or noise will not be tolerated.

1.22 DEMOLITION

A. Coordinate with other divisions before commencing work.

1.23 RECORD DOCUMENTS

A. Drawings: The Contractor shall maintain and update daily a set of "blueline" prints in the Field Office for the sole purpose of recording "installed" conditions. Revise the drawings to reflect as-built conditions, including all addenda, change orders, final shop drawing reviews, and field routing. Underground utilities shall be dimensionally located relative to readily accessible and identifiable permanent reference points, with accurate slope and elevation indicated. Submit prints for review. Revise, certify accuracy, and provide two final sets to the Architect.

B. Owner's Manual: Prior to final acceptance, provide two bound volumes to the Architect. Index by subject. Include corrected submittals and shop drawings that reflect final review comments; installation, operation and maintenance instructions, parts lists, wiring diagrams, and piping diagrams; warranties.

1.24 INSPECTION, OBSERVATION, AND TESTING

A. Cooperate with Architect's representative and authorities having jurisdiction. Provide complete access to the work at reasonable times.

B. Cover-up: Prior to covering up work, or conducting observed tests, request observation as appropriate. Provide adequate advance notice defined as a minimum of five working days. In some cases the Architect's representative may waive observation; otherwise arrange for observed construction and testing prior to cover-up. Should the minimum required notice not be provided and the contractor covers up work requiring observation, such work shall be uncovered at contractor's expense.

C. Pre-Testing: Self-inspect, pre-test, and remedy work prior to performing observed test.

D. Sectional Work: In circumstances where a requirement for phased construction or other considerations dictate sectional construction and/or testing, notify the Architect when construction begins on the first section of a system, and when the first section will be ready for observed testing, as well as subsequent sections. Test in the largest practical sections.

1.25 WORK PERFORMED UNDER OTHER DIVISIONS

A. Refer to Division 2 for piped utilities beyond 5 feet from the building.

B. Refer to Division 26 for power wiring systems external to equipment and control panels; starters in motor centers; safety switches not integral to equipment or starters provided under Division 23.

C. Refer to Division 14 for kitchen, laboratory, medical and like equipment.

1.26 REFERENCE TO OTHER DIVISIONS

A. Refer to Division 26 for additional material requirements of electrical components provided under Division 23, such as loose starters, wiring and devices integral to equipment.

B. Refer to Division 2 for additional requirements governing excavation and backfill, supplemental to the requirements stated in this Division 23.

C. Comply with all requirements applicable to work required under this Division.

1.27 TESTING SERVICES

A. Additional Testing: In addition to any specified testing, the Architect may cause additional testing to be performed by an independent testing laboratory or any other qualified party. If such testing reveals deficient work by the Contractor, the Contractor shall pay for both the testing and remedial work. If such testing does not reveal deficient work by the Contractor, the Owner shall pay for the testing and the cost of repairing any damage caused by such testing.

B. Specified Testing Services: If independent testing services are specified regarding work under this Division, cooperate fully with the testing agency. Provide access to the work. Provide test holes and taps necessary. Remove work that is not tested on site, deliver to testing agency, and reinstall if undamaged; replace if damaged. Provide utilities, operational capability, and facilities for on-site testing as necessary.

1.28 WORK BY OWNER

A. The owner will award contracts on work which includes:

1. None.

1.29 OWNER FURNISHED PRODUCTS

A. Products furnished to the site and paid for by the Owner.

1. None.

END OF SECTION 23 05 00

SECTION 230510

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals.
3. Sleeves.
4. Escutcheons.
5. Grout.
6. Equipment installation requirements common to equipment sections.
7. Painting and finishing.
8. Concrete bases.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
1. PE: Polyethylene plastic.
2. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.

2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified, at no cost to the Owner. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

C. Solvent Cements for Joining Plastic Piping:
1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
2. PVC to ABS Piping Transition: ASTM D 3138.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw.
    g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.

h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble

mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Alteration of permanent construction is not acceptable. For equipment above hard ceilings, provide access panels. For all equipment above ceilings, access shall be available within three feet of ceiling opening or lay-in tile. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Painting of mechanical systems, equipment, and components is specified in Division 9 Section "Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."
8. Provide 6” high bases for air handling units and 4” bases for other equipment.

3.7 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 230510

SECTION 23 05 29
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Thermal-hanger shield inserts.
4. Fastener systems.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 23 Section "Vibration Controls for HVAC Piping and Equipment" for vibration isolation devices.
3. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.

C. Welding certificates.

PART 2 - PRODUCTS

2.1 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.2 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Cooper B-Line, Inc.
    b. Flex-Strut Inc.
    c. Hayden Corp.
    d. Powerstrut Corp.
    e. Thomas & Betts Corporation.
    f. Unistrut Corporation; Tyco International, Ltd.
    g. Wesanco, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Hot-dipped galvanized.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Allied Tube & Conduit.
    b. Anvil International; a subsidiary of Mueller Water Products Inc.
    c. Empire Industries, Inc.
    d. ERICO International Corporation.
    e. GS Metals Corp.
    f. NIBCO INC.
    g. PHD Manufacturing, Inc.
    h. PHS Industries, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.

5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Hot dipped galvanized.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

3.2 EQUIPMENT SUPPORTS

A. Grouting: Place grout under supports for equipment and make bearing surface smooth.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use coated carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.

F. Use padded hangers for piping that is subject to scratching.

G. Use thermal-hanger shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
7. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
8. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
9. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
10. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
11. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
12. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
13. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.

8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 23 05 29

SECTION 23 05 48

VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Isolation mounts.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

B. Welding certificates.

C. Qualification Data: For professional engineer under delegated designs requirements.

D. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated in this specification or a comparable product by one of the following:

1. Amber/Booth Company, Inc.
2. Vibro-Acoustics.
3. Mason Industries.

B. Mounts (Mason Industries #ND): Double-deflection type, with molded, neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range. Select with minimum deflection of 0.35" for application.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

2.2 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and wind-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Install Vibration control devices in accordance with schedule herein.

3.3 VIBRATION-CONTROL DEVICE INSTALLATION

A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

C. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Test to 90 percent of rated proof load of device.
3. Measure isolator restraint clearance.
4. Measure isolator deflection.
5. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust air-spring leveling mechanism.

D. Adjust active height of spring isolators.

E. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Division 01 Section "Demonstration And Training."

3.7 HVAC VIBRATION-CONTROL DEVICE SCHEDULE

A. Air Handling Units

1. Equipment Location: Floor.
2. Isolator Type: Isolation Mount.
3. Minimum Deflection:0.35."

END OF SECTION 230548

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - **GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Duct labels.
4. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch Stainless steel, 0.025-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

3. Minimum Letter Size: 1/2 inch for name of units for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/2 inch for name of units for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 DUCT LABELS

A. General Requirements for Manufactured Duct Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Self-Adhesive Duct Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.4 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Balancing Air Systems

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 45 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. Certified TAB reports.

E. Sample report forms.

F. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician.

B. TAB Conference: Meet with General Contractor and HVAC Engineer (and, if applicable Commissioning Authority) on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Coordination and cooperation of trades and subcontractors.
d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved by Engineer.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 233113 "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as zone control dampers, and verify that they are accessible and their controls are connected and functioning.

K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

L. Examine operating safety interlocks and controls on HVAC equipment.

M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Automatic temperature-control systems are operational.
3. Equipment and duct access doors are securely closed.
4. Balance, smoke, and fire dampers are open.
5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
6. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Where insufficient space is available for Pitot-tube traverse measurement, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

    a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    b. Measure static pressure directly at the fan outlet or through the flexible connection.
    c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

    a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

6. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.7 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

B. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.8 TOLERANCES

A. Set HVAC system's air flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

3.9 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.10 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Fan curves.

2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Fan drive settings including settings and percentage of maximum pitch diameter.
    e. Inlet vane settings for variable-air-volume systems.
    f. Settings for supply-air, static-pressure controller.
    g. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Duct, outlet, and inlet sizes.
3. Terminal units.
4. Balancing stations.
5. Position of balancing devices.

E. Rooftop Unit Test Reports:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.

e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches, and bore.
i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Cooling-coil static-pressure differential in inches wg.
g. Outdoor airflow in cfm.
h. Return airflow in cfm.
i. Outdoor-air damper position.
j. Return-air damper position.

F. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

G. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft.
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

H. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Air velocity in fpm.
c. Preliminary air flow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final air flow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

I. System-Coil Reports: For reheat coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.

2. Test Data (Indicated and Actual Values):

    a. Air flow rate in cfm.
    b. Entering-air temperature in deg F.
    c. Leaving-air temperature in deg F.

J. Instrument Calibration Reports:

1. Report Data:

    a. Instrument type and make.
    b. Serial number.
    c. Application.
    d. Dates of use.
    e. Dates of calibration.

3.11 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:

    a. Measure airflow of at least 10 percent of air outlets.
    b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
    c. Verify that balancing devices are marked with final balance position.
    d. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made Engineers.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Project HVAC Engineer.
3. HVAC engineer randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.12 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

C. T & B contractor shall include 16 hours of time dedicated to verification of final Test and Balance Report. This shall be done on-site, with instruments, and in the presence of the Commissioning Agent (Cx). Cx shall require random system testing. If more than 10% of tests are beyond reported value tolerances. The entire report is subject to re-test in its entirety.

END OF SECTION 230593

SECTION 23 07 13
DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, concealed return and exhaust located in unconditioned space.

B. Related Sections:

1. Division 23 Section "HVAC Equipment Insulation."
2. Division 23 Section "Metal Ducts" for duct liners.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

C. Qualification Data: For qualified Installer.

D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

E. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290 Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; SoftTouch Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Friendly Feel Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; SOFTR All-Service Duct Wrap.

G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; Commercial Board.
b. Johns Manville; 800 Series Spin-Glas.
c. Knauf Insulation; Insulation Board.
d. Manson Insulation Inc.; AK Board.
e. Owens Corning; Fiberglas 700 Series.

2.2 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; FlameChek.
b. Johns Manville; Firetemp Wrap.
c. Nelson Fire Stop Products; Nelson FSB Flameshield Blanket.
d. Thermal Ceramics; FireMaster Duct Wrap.
e. 3M; Fire Barrier Wrap Products.
f. Unifrax Corporation; FyreWrap.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand; CP-127.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand; CP-82.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand; 85-60.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor/outdoor use on below-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand; 30-80/30-90.
b. Childers Brand; CP-38

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Brand; CP-50 AHV2.
    b. Foster Brand; 30-36.
    c. Vimasco Corporation; 713 and 714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.6 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Brand; CP-76.
    b. Eagle Bridges - Marathon Industries; 405.
    c. Foster Brand; 95-44.
    d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Brand, Specialty Construction Brands, Inc.; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

2.9 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. ABI, Ideal Tape Division; 491 AWF FSK.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   c. Compac Corporation; 110 and 111.
   d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. ABI, Ideal Tape Division; 488 AWF.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
   c. Compac Corporation; 120.
   d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Stainless Steel: ASTM A 167 or ASTM A 240, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; CD.
      3) Midwest Fasteners, Inc.; CD.
      4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) AGM Industries, Inc.; CHP-1.
      2) GEMCO; Cupped Head Weld Pin.
      3) Midwest Fasteners, Inc.; Cupped Head.
      4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
      2) GEMCO; Perforated Base.
      3) Midwest Fasteners, Inc.; Spindle.

   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

c. Spindle: Aluminum, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
2) GEMCO; Peel & Press.
3) Midwest Fasteners, Inc.; Self Stick.

b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; RC-150.
2) GEMCO; R-150.
3) Midwest Fasteners, Inc.; WA-150.
4) Nelson Stud Welding; Speed Clips.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. C & F Wire.

2.11 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Division 07 Section "Penetration Firestopping"firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and

inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

3.7 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

3.8 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

B. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be

limited to one location for each duct system defined in the "Duct Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return and exhaust located in unconditioned space.
4. Indoor, exposed return and exhaust located in unconditioned space.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.11 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

B. Concealed, round and flat-oval, return-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

C. Concealed, rectangular, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

D. Concealed, rectangular, return-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

END OF SECTION 230713

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following HVAC piping systems:

1. Condensate drain piping.
2. Refrigerant suction and hot-gas piping.

B. Related Sections:

1. Section 230713 "Duct Insulation."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand; 85-75.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand; CP-82.
b. Foster Brand; 85-60.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Dow Corning Corporation; 739, Dow Silicone.
    b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor/outdoor use on below-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Foster Brand; 30-80/30-90.

    b. Childers Brand; CP-38

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Brand; CP-76.
    b. Foster Brand; 95-44.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene or polypropylene backing; complying with ASTM C 1136, Type II.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSP Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with polyethylene or polypropylene jacketing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.
2. Color: White.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

    a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Metal Jacket:

1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

    a. Sheet and roll stock ready for shop or field sizing.
    b. Finish and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    e. Factory-Fabricated Fitting Covers:

        1) Same material, finish, and thickness as jacket.
        2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
        3) Tee covers.
        4) Flange and union covers.
        5) End caps.

6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.7 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Width: 2 inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

2.8 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015 inch thick, 3/4 inch wide with closed seal.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with closed seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt

each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK or FSP jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof

sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.8 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless-steel jackets.

3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 3/4 inch thick.

B. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

C. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

3.11 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1-1/2 inch thick.

B. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 2 inches thick.

C. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 2 inches thick.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. FSP-factory.

D. Piping, Exposed:

1. PVC: 20 mils thick.

3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. PVC: 20 mils thick.

D. Piping, Exposed:

1. Aluminum, Smooth 0.020 inch thick.

END OF SECTION 230719

SECTION 23 31 13
METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work. Scale: 1/4" =1'-0".
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.

4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to 1/4" = 1' -0" scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.

3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round and flat-oval ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with the latest edition of SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Unconditioned Space, Supply-Air Ducts in Pressure Classes 1-1/2-Inch wg and Lower: Seal Class B.
3. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 1- 1/2-Inch wg: Seal Class A.
4. Unconditioned Space, Exhaust Ducts: Seal Class C.
5. Unconditioned Space, Return-Air Ducts: Seal Class B.
6. Conditioned Space, Supply-Air Ducts in Pressure Classes 1-1/2-Inch wg and Lower: Seal Class C.
7. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 1-1/2-Inch wg: Seal Class B.
8. Conditioned Space, Exhaust Ducts: Seal Class B.
9. Conditioned Space, Return-Air Ducts: Seal Class C.

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.5 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with the latest edition of SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

    a. Supply Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 95 percent of total installed duct area for each designated pressure class.
    b. Return Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 95 percent of total installed duct area for each designated pressure class.
    c. Exhaust Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections totaling no less than 95 percent of total installed duct area for each designated pressure class.
    d. Outdoor Air Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 95 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give five days' advance notice for testing.

3.7 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.

2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, condensate drain pans, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

D. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.8 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel.

B. Supply Ducts:

1. Ducts Connected to Constant-Volume Air-Handling Units:

   a. Pressure Class: Positive 1-inch wg.
   b. Minimum SMACNA Seal Class: Unconditioned – B. Conditioned-C.

2. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive 1-inch wg.
b. Minimum SMACNA Seal Class: Unconditioned – B. Conditioned-C.

C. Return Ducts:

1. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 1 inch wg.
b. Minimum SMACNA Seal Class: Unconditioned – B. Conditioned-None.

2. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 1-inch wg.
b. Minimum SMACNA Seal Class: Unconditioned – B. Conditioned-None.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 1-inch wg.
b. Minimum SMACNA Seal Class: C.

2. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: B.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

F. Elbow Configuration:

1. Rectangular Duct: Comply with the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity 1500 fpm or lower:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Mitered Type RE 2 with vanes complying with the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows." Type RE2 to be used only when types RE1 and RE3 are not physically allowed. Mitered elbows are only to be used on 90° angles and only when type RE1 fittings cannot be used.
3) Square throat, radius heel elbows will not be allowed under any circumstances.

b. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows." Type RE2 to be used only when types RE1 and RE3 are not physically allowed. Mitered elbows

are only to be used on 90° angles and only when type RE1 fittings cannot be used.

3) Square throat, radius heel elbows will not be allowed under any circumstances.

2. Round Duct: Comply with the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1500 fpm or lower: 1.0 centerline radius-to-diameter ratio and four segments for 90-degree elbow.

2) Velocity 1500 fpm or Higher: 1.5 centerline radius-to-diameter ratio and five segments for 90-degree elbow.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped, gored or pleated.

c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam, gored or Welded.

G. Branch Configuration:

1. Rectangular Duct: Comply with the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.

b. Rectangular Main to Round Branch under 1000 fpm: Spin in.

c. Rectangular Main to Round Branch over 1000 fpm: Conical Spin in or 45-degree entry.

2. Round and Flat Oval: Comply with the latest edition of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1500 fpm or Lower: Conical tap.

b. Velocity 1500 fpm or Higher: 45-degree lateral, 45-degree entry tap or conical tap with 4-inch larger base than tap.

END OF SECTION 233113

SECTION 23 31 14
NON-FIBROUS, CLOSED CELL, OUTDOOR DUCTWORK

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes:

1. Outdoor duct.

1.2 SUBMITTALS

A. Product data: For each type of product indicated.

B. Shop drawings: Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work including.

1. Duct layout indicating sizes and pressure classes.
2. Elevation of top of ducts.
3. Dimensions of main duct runs from building grid lines.
4. Fittings.
5. Penetrations through fire-rated and other partitions.

C. Coordination Drawings: Plans, drawn to scale, showing coordination general construction, building components, and other building services.

1.3 QUALITY ASSURANCE

A. Installer Qualifications:

1. Trained field mechanics who demonstrate competence in the HVAC industry.

B. Provide 10 year leakage warranty on installed product.

1.4 SPECIFICATION COMPLIANCE.

A. Duct Leakage Class, follow SMACNA Leakage Class 3 or less.

B. Inner liner compliant to UL (C-UL) 181 Standard for Safety Listed, Class 1 system.

C. ASTM E2257 Standard Test Method for Room Fire Test of Wall and Ceiling Materials and Assemblies, ASTM E 84 tested, Tunnel Test, Does not exceed 25 flame spread, 50 smoke developed., ASTM C 423 noise reduction, ASTM E 96/E 96M Procedure A for permeability, ASTM C 1071 for erosion

D. ASTM C 518: 2004, Standard Test Method for Steady–State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

E. UL 723, Test for Surface Burning Characteristics of Building Materials

F. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems"
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems"

3. NFPA 255, “Standard Method of Test of Surface Burning Characteristics

G. Outer shell shall be a UV stable 1000 micron high impact resistant titanium infused vinyl with included testing as following;

1. UL-94 Flammability V-0
2. ASTM D-638 Tensile Strength of 6250 psi, ASTM D-790 Flexible Strength of 11,000 psi, ASTM D-4226 Drop Impact Resistance, ASTM D-4216 Cell Classification

PART 2 – PRODUCTS

2.1 OUTDOOR MOUNTED RECTANGULAR DUCT AND FITTINGS

A. Product:

1. Thermaduct.

B. The panel shall be manufactured of CFC-free closed cell rigid thermoset resin thermally bonded on both sides to a factory applied .001" aluminum foil facing reinforced with a fiberglass scrim. An added UV stable, 1000 micron high impact resistant titanium infused vinyl is factory bonded to the outer surfaces to provide a zero permeability water tight barrier.

C. The thermal conductivity shall be no greater than 0.13BTU x in/Hr x ft2 x°F.

D. The density of the foam shall not be less than 3.5 pcf with a minimum compressive strength of 28 psi.

E. The closed cell rigid thermoset resin panel shall be 1 ¾” R-Value 12.

F. Properties

1. Maximum Temperature: Continuous rating of 185 degrees F (70 deg C) inside ducts or ambient temperature surrounding ducts.
2. Maximum Thermal Conductivity: 0.13 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
3. Permeability: 0.00 perms maximum when tested to ASTM E 96/E 96M, Procedure A.
4. Antimicrobial Agent: Additive for antimicrobial shall not be used but instead, raw product must pass UL bacteria growth testing.
5. Noise-Reduction Coefficient: 0.05 minimum when tested to ASTM C 423, Mounting A.
6. All interior duct liner shall bear UL label on panel and internal closure materials.

G. Duct connectors shall be factory manufactured cohesive bonded strips, all aluminum grip flange, and galvanized 4-bolt flange. Flange covering consists of the following foam tape insulation with molded 1000 micron covers and air gap (heating only application) with molded 1000 micron covers.

H. Outdoor Cladding

1.Outdoor installation duct segments shall incorporate UV stable 1000 micron high impact resistant titanium infused vinyl which is introduced during the manufacturing process.

I. Installation

1. Hangers and tie-downs are to be detailed on the manufacturer’s installing contractors detail drawings prior to installation but not exceeding 13’ for duct girth <84” and 8’ for

duct girth >85" between hangers and designed to carry the weight and wind load of the ductwork.

PART 3 – EXECUTION

3.1 Shop Fabrication

A. Certification:

1. Ducts shall be detailed and fully factory manufactured by an authorized Thermaduct, LLC facility system. All fabrication labor will be certified "yellow label" building trade professionals, compliant to SMWIA and SMACNA labor guidelines (work preservation observed).

B. Fabrication:

1. Designed and fabricated duct segments and fittings will be in accordance with "SMACNA Duct Construction Standards" latest edition.
2. Both positive and negative ductwork and fittings shall be constructed to incorporate a UL Listed as a Class 1 air duct to Standard for Safety UL 181 liner with an exterior clad for permanent protection against water intrusion.
3. Duct shall be constructed to exceed requirements for snow and wind loads.

3.2 DUCT INSTALLATION

A. Duct segments shall be installed be competent HVAC installers.

B. Install ducts and fittings to comply with manufacturer's installation manuals.

C. Air Leakage: Duct air leakage rates to be in compliance with "SMACNA HVAC Duct Construction Standards" latest version per applicable leakage class based on pressure.

3.3 HANGER AND SUPPORT INSTALLATION

A. Contractor to ensure that the ductwork system is properly and adequately supported.

1. Ensure that the chosen method is compatible with the specific ductwork system requirements per manufacturer installation detail drawings. Pre-installation should be provided prior to work commencement by installing contractor for approval.
2. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Ductwork shall be supported at changes of direction, at branch duct connections, tee fittings, parallel under turning vanes and all duct accessories such as dampers, etc.

END OF SECTION 233114

SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Manual volume dampers.
2. Fire dampers.
3. Flange connectors.
4. Duct-mounted access doors.
5. Flexible connectors.
6. Flexible ducts.
7. Duct accessory hardware.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control-damper installations.
d. Fire-dampers including sleeves; and duct-mounted access doors.
e. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to 1/4"=1'-0"scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480 Type 304, and having a No. 2 finish for concealed ducts and No. 4D finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ruskin #MD25 (rectangular) or #MDRS25 (round) or comparable product by one of the following:

    a. Flexmaster U.S.A., Inc.
    b. Nailor Industries Inc.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:

a. Frame: Hat-shaped, 20 gauge, galvanized sheet steel.
b. Mitered corners.
c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Galvanized-steel, 20 gauge.

6. Blade Axles: Galvanized steel.
7. Bearings:

a. Molded synthetic.
b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

2.4 FIRE DAMPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Ruskin #IBD2 (1-1/2hr, rectangular), #FDR25 (1-1/2 hour, round), #IBD2-B3 (3hour, rectangular) or comparable product by one of the following:

1. Cesco Products.
2. Greenheck Fan Corporation.
3. Nailor Industries Inc.

B. Type: Static; rated and labeled according to UL 555 by an NRTL.

C. Fire Rating: 1-1/2 and 3 hours.

D. Frame: fabricated with roll-formed, 20 gauge thick galvanized steel; with mitered and interlocking corners.

E. Mounting Sleeve: Factory installed, galvanized sheet steel.

1. Minimum Thickness: 20 gauge thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: 24 gauge curtain type.

H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

I. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

J. Access Door: Factory installed in sleeve.

2.5 FLANGE CONNECTORS

A. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

B. Material: Galvanized steel.

C. Gage and Shape: Match connecting ductwork.

2.6 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:

1. Cesco Products.
2. Ductmate Industries, Inc.
3. Flexmaster U.S.A., Inc.
4. Greenheck Fan Corporation.
5. Nailor Industries Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Vision panel.
   d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
   e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches Square: Continuous and two sash locks.
   c. Access Doors up to 24 by 48 Inches: [Three hinges] Continuous and two compression latches with outside and inside handles.
   d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

2.7 FLEXIBLE CONNECTORS

A. Materials: Flame-retardant or noncombustible fabrics.

B. Coatings and Adhesives: Comply with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 22 gauge galvanized sheet steel or 20 gauge aluminum sheets. Provide metal compatible with connected ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd.
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

2.8 FLEXIBLE DUCTS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Flexmaster #1MR6 or comparable product by one of the following:

1. McGill AirFlow LLC.
2. Thermaflex.

B. Core material shall be an acoustical transparent PE fabric supported by helically wound galvanized steel. The fabric shall be mechanically fastened to the steel helix without the use of adhesive. The core shall maintain its free area and a center line radius of 1.0 or better

C. The internal working pressure rating shall be at least as follows with a bursting pressure of at least 2-1/2 times the working pressure.

1. Positive: 10 inches W.G. thru 20” diameter
2. Negative: 5 inches W.G. thru 16” diameter

D. The duct shall be rated for a velocity of at least 5500 feet per minute.

E. The duct must be suitable for continuous operation at a temperature range of -20° F to +250° F.

F. Acoustical performance, when tested by an independent laboratory in accordance with the Air Diffusion Council’s Flexible Air Duct Test Code FD 72-R1, Section 3.0, Sound Properties, shall be as follows:

1. The insertion loss (dB) of a 6 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 1000 feet per minute, shall be at least:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
8” diameter	5	10	22	34	22	17
12” diameter	6	27	22	28	18	11

G. Factory insulate the flexible duct with flexible fiberglass insulation. The R value shall be at least 6.0 at a mean temperature of 75 degrees F. (R4.2 not acceptable)

H. Cover the insulation with a reinforced aluminum pigmented vapor barrier jacket having a permeance of not greater than 0.05 perms when tested in accordance with ASTM E 96, procedure A.

I. The ductwork shall be UL 181 listed, Class 1 Air Duct and comply with NFPA 90A and 90B

J. Flexible Duct Connectors:

1. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.

2.9 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.

4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. Upstream or downstream from duct silencers.
8. Control devices requiring inspection.
9. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

O. Connect diffusers or light troffer boots to ducts with maximum 72 inches lengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with draw bands.

Q. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 23 34 23

HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Centrifugal roof ventilators.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on sea level.

B. Operating Limits: Classify according to AMCA 99.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to 1/4” = 1’-0” scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.8 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Loren Cook Company.
3. PennBarry.

B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains and grease collector.
2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Direct Drive.

E. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent for direct drive fans.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.

F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.

1. Configuration: As required.
2. Overall Height: 12 inches minimum.
3. Sound Curb: Curb with sound-absorbing insulation.
4. Pitch Mounting: Manufacture curb for roof slope.
5. Metal Liner: Galvanized steel.
6. Mounting Pedestal: Galvanized steel with removable access panel.
7. Vented Curb: Unlined with louvered vents in vertical sides (on kitchen exhaust fans only).

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Enclosure Type: Totally enclosed, fan cooled.

2.3 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Support units using spring isolators having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548 "Vibration Controls for HVAC Piping and Equipment."

C. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.

D. Install units with clearances for service and maintenance.

E. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust damper linkages for proper damper operation.
6. Verify lubrication for bearings and other moving parts.

7. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
8. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
9. Shut unit down and reconnect automatic temperature-control operators.
10. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

C. Lubricate bearings.

END OF SECTION

SECTION 23 37 13
DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Adjustable bar registers and grilles.

B. Related Sections:

1. Section 089000 "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to 1/4" = 1'-0" scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Nailor Industries Inc.
    b. Price Industries.
    c. Titus.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Aluminum.
4. Finish: Baked enamel, white unless otherwise specified.
5. Face Size: 24 by 24 inches for layin and surface-mount 12 by 12 inches for surface-mount. Refer to plans and schedules.
6. Face Style: cone or Plaque. Refer to schedule.
7. Mounting: Surface T-bar. Refer to schedule.
8. Pattern: Fixed.
9. Dampers: None.
10. Accessories: As scheduled.

2.2 REGISTERS AND GRILLES

A. Adjustable Bar Grilles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Nailor Industries Inc.
    b. Price Industries.
    c. Titus.

2. Material: Aluminum.
3. Finish: Baked enamel, white unless otherwise scheduled.
4. Face Blade Arrangement: As scheduled.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: As scheduled.
7. Frame: 1-1/4 inches wide.
8. Mounting: As scheduled.
9. Damper Type: As scheduled.

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 23 74 13

PACKAGED DX UNITS – DOUBLE WALL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged, outdoor air-handling units (rooftop units) with the following components and accessories:

1. Direct-expansion cooling.
2. Integral, space temperature controls.

1.3 DEFINITIONS

A. DDC: Direct-digital controls.

B. ECM: Electrically commutated motor.

C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

D. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

E. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

F. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

G. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

H. VAV: Variable-air volume.

1.4 **ACTION SUBMITTALS**

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and other details, drawn to 1/4" = 1'-0" scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Building and concrete slab.
2. Duct.
3. Vibration isolation devices.

B. Field quality-control test reports.

C. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: One set for each belt-driven fan.
2. Filters: One set of filters for each unit.

1.8 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.
2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.

3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. UL Compliance: Comply with UL 1995.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period. The warranty period shall commence at startup.

1. 1 Year Parts.
2. 5 Years Compressor Parts.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Daikin.
2. Carrier.
3. Trane.
4. Aaon.

2.2 GENERAL DESCRIPTION

A. Furnish as shown on plans. Unit performance and electrical characteristics shall be per the job schedule.

B. Configuration: Fabricate as detailed on prints and drawings:

1. Return plenum / economizer section
2. Filter section
3. Cooling coil section
4. Supply fan section
5. Condensing unit section

C. The complete unit shall be cETLus listed.

D. The unit shall be ASHRAE 90.1-2013 compliant and labeled.

E. Each unit shall be specifically designed for outdoor rooftop application and include a weatherproof cabinet. Each unit shall be completely factory assembled and shipped in one piece. Packaged units shall be shipped fully charged with R-410 Refrigerant and oil.

F. The unit shall undergo a complete factory run test prior to shipment. The factory test shall include a refrigeration circuit run test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection.

G. All units shall have decals and tags to indicate caution areas and aid unit service. Unit nameplates shall be fixed to the main control panel door. Electrical wiring diagrams shall be attached to the control panels. Installation, operating and maintenance bulletins and start-up forms shall be supplied with each unit.

H. Performance: All scheduled EER, IEER, capacities and face areas are minimum accepted values. All scheduled amps, kW, and HP are maximum accepted values that allow scheduled capacity to be met.

I. Warranty: The manufacturer shall provide 12-month parts only warranty. Defective parts shall be repaired or replaced during the warranty period at no charge. The warranty period shall commence at startup or six months after shipment, whichever occurs first.

2.3 CABINET, CASING, AND FRAME

A. Panel construction shall be double-wall construction for all panels. All floor panels shall have a solid galvanized steel inner liner on the air stream side of the unit to protect insulation during service and maintenance. Insulation shall be a minimum of 1" thick with an R-value of 7, and shall be 2 part injected foam. Panel design shall include no exposed insulation edges. Unit cabinet shall be designed to operate at total static pressures up to 5.0 inches w.g.

B. Exterior surfaces shall be constructed of pre-painted galvanized steel for aesthetics and long term durability. Paint finish to include a base primer with a high quality, polyester resin topcoat of a neutral beige color. Finished panel surfaces to withstand a minimum 750-hour salt spray test in accordance with ASTM B117 standard for salt spray resistance.

C. Service doors shall be provided on the fan section, filter section, control panel section, and heating vestibule in order to provide user access to unit components. All service access doors shall be mounted on multiple, stainless steel hinges and shall be secured by a latch system. Removable service panels secured by multiple mechanical fasteners are not acceptable.

D. The unit base shall overhang the roof curb for positive water runoff and shall seat on the roof curb gasket to provide a positive, weathertight seal. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment.

2.4 OUTDOOR AIR DAMPER SECTION

A. Unit shall be provided with a 0~30% outdoor air damper and mixing section. The outdoor air hood shall be factory installed and constructed from the same durable paint finish as the main unit. The hood shall include moisture eliminator filters to drain water away from the entering air stream. The damper blades shall be gasketed with side seals to provide an air leakage rate of 4 cfm/square foot of damper area at 1” differential pressure per ASHRAE 90.1 Energy Standard. Control of the dampers shall be by a factory installed direct coupled actuator. Damper actuator shall be of the modulating, spring return type. The unit controller shall be capable of resetting the minimum damper position.

2.5 AIR FILTRATION

A. Unit shall be provided with a draw-through filter section. The filter rack shall be designed to accept a 2" pre-filter and a 4" final filter. The unit design shall have a hinged access door for the filter section. The manufacturer shall ship the rooftop unit with 2" MERV 8 construction filters. The contractor shall furnish and install, at building occupancy, the final set of filters per the contract documents.

2.6 COOLING COIL

A. The indoor coil section shall be installed in a draw through configuration, upstream of the supply air fan. The coil section shall be complete with a factory piped cooling coil and an ASHRAE 62.1 compliant double sloped drain pan.

B. The direct expansion (DX) cooling coils shall be fabricated of seamless high efficiency copper tubing that is mechanically expanded into high efficiency aluminum plate fins. Coils shall be a multi-row, staggered tube design with a minimum of 3 rows. All cooling coils shall have an interlaced coil circuiting that keeps the full coil face active at all load conditions. All coils shall be factory leak tested with high pressure air under water.

C. The cooling coil shall have an electronic controlled expansion valve. The unit controller shall control the expansion valve to maintain liquid sub-cooling and the superheat of the refrigerant system.

D. The refrigerant suction lines shall be fully insulated from the expansion valve to the compressors.

E. The drain pan shall be stainless steel and positively sloped. The slope of the drain pan shall be in two directions and comply with ASHRAE Standard 62.1. The drain pan shall have a minimum slope of 1/8" per foot to provide positive draining. The drain pan shall extend beyond the leaving side of the coil. The drain pan shall have a threaded drain connection extending through the unit base.

F. A drain pan over flow safety shall shut of the unit and issue a warning before over flow occurs.

2.7 HOT GAS REHEAT

A. Unit shall be equipped with a fully modulating hot gas reheat coil with hot gas coming from the unit condenser.

B. Hot gas reheat coil shall be a Micro Channel design. The aluminum tube shall be a micro channel design with high efficiency aluminum fins. Fins shall be brazed to the tubing for a direct bond. The capacity of the reheat coil shall allow for a 20°F temperature rise at all operating conditions.

C. The modulating hot gas reheat systems shall allow for independent control of the cooling coil leaving air temperature and the reheat coil leaving air temperature. The cooling coil and reheat coil leaving air temperature setpoints shall be adjustable through the unit controller. During the dehumidification cycle the unit shall be capable of 100% of the cooling capacity. The hot gas reheat coil shall provide discharge temperature control within +/- 2°F.

D. Each coil shall be factory leak tested with high-pressure air under water.

2.8 SUPPLY FAN

A. Supply fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with fan blades that are continuously welded to the hub plate and end rim. The supply fan shall be a direct drive fan mounted to the motor shaft.

B. All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment.

C. Supply fan and motor assembly combinations larger than 8 hp or 22" diameter shall be internally isolated on 1" deflection, spring isolators and include removable shipping tie downs.

D. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.

E. The supply fan shall be capable of airflow modulation from 30% to 100% of the scheduled designed airflow. The fan shall not operate in a state of surge at any point within the modulation range.

2.9 VARIABLE AIR VOLUME CONTROL

A. The unit controller shall control the supply fan based on space temperature. The unit controller shall increase/decrease the speed of the supply fan in order to maintain the space temperature within its setpoint and deadband. The unit controller shall provide discharge air temperature control with compressor modulation.

B. Unit controller shall modulate ECM motor.

C. The unit manufacturer shall install all power and control wiring.

D. The supply air fan drive output shall be controlled by the factory installed main unit control system and drive status and operating speed shall be monitored and displayed at the main unit control panel.

2.10 HEATING COIL

A. The rooftop unit shall include an electrical resistance heating coil section. Staged electric heating coil modules shall be factory installed downstream of the supply air fan in the heating section of the rooftop unit. Heating coils shall be constructed of a low watt density, nickel - chromium alloy resistance wire with intermediate supports that include ceramic bushings. The electrical contactors shall be of the full line-breaking type with all the electrical power legs being disconnected when the contactors are not energized. All electrical circuit wiring shall be designed with copper conductors, aluminum wires are not acceptable. Heating element branch circuits shall be individually fused to a maximum of 48 Amps per NEC requirements. The power supply for the electric heater shall be factory wired into the units main power block or disconnect switch.

B. The heating modules shall have an automatic reset, high temperature limit safety protection. A secondary high limit protection shall also be provided that requires a manual reset. An airflow

switch shall be provided with the heating module to prevent the electric heater from operating in the event of no airflow.

C. The electric heat elements shall be controlled by the factory installed DDC unit control system. The heater shall have proportional SCR control. The unit controller shall modulate the electric heater to maintain the discharge air temperature setpoint.

D. Field installed heating modules shall require a field ETL certification. Duct heaters mounted within the rooftop unit in the field shall not be acceptable. The manufacturer's rooftop unit ETL certification shall cover the complete unit including the electric heating modules.

2.11 CONDENSING SECTION

A. Outdoor coils shall be cast aluminum, micro-channel coils. Plate fins shall be protected and brazed between adjoining flat tubes such that they shall not extend outside the tubes. A sub-cooling coil shall be an integral part of the main outdoor air coil. Each outdoor air coil shall be factory leak tested with high-pressure air under water.

B. Outdoor air coils shall be protected from incidental contact to coil fins by a coil guard. Coil guard shall be constructed of cross wire welded steel with PVC coating.

C. Fan motors shall be an ECM type motor for proportional control. The unit controller shall proportionally control the speed of the condenser fan motors to maintain the head pressure of the refrigerant circuit from ambient condition of 0~120°F. Mechanical cooling shall be provided to 25º F. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase.

D. The condenser fan shall be low noise blade design. Fan blade design shall be a dynamic profile for low tip speed. Fan blade shall be of a composite material.

E. The unit shall have scroll compressors. One of the compressors shall be an inverter compressor providing proportional control. The unit controller shall control the speed of the compressor to maintain the discharge air temperature. The inverter compressor shall have a separate oil pump and an oil separator for each compressor that routes oil back to the compressor instead of through the discharge line.

F. Pressure transducers shall be provided for the suction pressure and head pressure. Temperature sensor shall be provided for the suction temperature and the refrigerant discharge temperature of the compressors. All of the above devices shall be an input to the unit controller and the values be displayed at the unit controller.

G. Each circuit shall be dehydrated and factory charged with R-410A Refrigerant and oil.

2.12 ELECTRICAL

A. Unit wiring shall comply with NEC requirements and with all applicable UL standards. All electrical components shall be UL recognized where applicable. All wiring and electrical components provided with the unit shall be number and color-coded and labeled according to the electrical diagram provided for easy identification. The unit shall be provided with a factory wired weatherproof control panel. Unit shall have a single point power terminal block for main power connection. A terminal board shall be provided for low voltage control wiring. Branch short circuit protection, 115-volt control circuit transformer and fuse, system switches, and a

high temperature sensor shall also be provided with the unit. Each compressor and condenser fan motor shall be furnished with contactors and inherent thermal overload protection. Supply fan motors shall have contactors and external overload protection. Knockouts shall be provided in the bottom of the main control panels for field wiring entrance.

B. A single non-fused disconnect switch shall be provided for disconnecting electrical power at the unit. Disconnect switches shall be mounted internally to the control panel and operated by an externally mounted handle.

C. A GFI receptacle shall be unit mounted. The receptacle will require a field power connection independent from the unit's main power block and/or disconnect.

2.13 CONTROLS

A. Provide a complete integrated microprocessor based Direct Digital Control (DDC) system to control all unit functions including temperature control, scheduling, monitoring, unit safety protection, including compressor minimum run and minimum off times, and diagnostics. This system shall consist of all required temperature sensors, pressure sensors, controller and keypad/display operator interface. All MCBs and sensors shall be factory mounted, wired and tested.

B. The stand-alone DDC controllers shall not be dependent on communications with any on-site or remote PC or master control panel for proper unit operation. The microprocessor shall maintain existing set points and operate stand-alone if the unit loses either direct connect or network communications. The microprocessor memory shall be protected from voltage fluctuations as well as any extended power failures. All factory and user set schedules and control points shall be maintained in nonvolatile memory. No settings shall be lost, even during extended power shutdowns.

C. The DDC control system shall permit starting and stopping of the unit locally or remotely. The control system shall be capable of providing a remote alarm indication. The unit control system shall provide for outside air damper actuation, emergency shutdown, remote heat enable/disable, remote cool enable/disable, heat indication, cool indication, and fan operation.

D. All digital inputs and outputs shall be protected against damage from transients or incorrect voltages. All field wiring shall be terminated at a separate, clearly marked terminal strip

E. The DDC controller shall have a built-in time schedule. The schedule shall be programmable from the unit keypad interface. The schedule shall be maintained in nonvolatile memory to insure that it is not lost during a power failure. There shall be one start/stop per day and a separate holiday schedule. The controller shall accept up to sixteen holidays each with up to a 5-day duration. Each unit shall also have the ability to accept a time schedule via BAS network communications.

F. The keypad interface shall allow convenient navigation and access to all control functions. The unit keypad/display character format shall be 4 lines x 20 characters. All control settings shall be password protected against unauthorized changes. For ease of service, the display format shall be English language readout. Coded formats with look-up tables will not be accepted. The user interaction with the display shall provide the following information as a minimum:

1. Return air temperature.
2. Discharge air temperature.
3. Outdoor air temperature.
4. Space air temperature.

5. Outdoor enthalpy, high/low.
6. Compressor suction temperature and pressure
7. Compressor head pressure and temperature
8. Expansion valve position
9. Condenser fan speed
10. Inverter compressor speed
11. Dirty filter indication.
12. Airflow verification.
13. Cooling status.
14. Control temperature (Changeover).
15. Cooling status/capacity.
16. Unit status.
17. All time schedules.
18. Active alarms with time and date.
19. Previous alarms with time and date.
20. Optimal start
21. Supply fan and exhaust fan speed.
22. System operating hours.
    a. Fan
    b. Exhaust fan
    c. Cooling
    d. Individual compressor
    e. Heating
    f. Tenant override

G. The user interaction with the keypad shall provide the following:
1. Controls mode
    a. Off manual
    b. Auto
    c. Heat/Cool
    d. Cool only
    e. Heat only
    f. Fan only
2. Occupancy mode
    a. Auto
    b. Occupied
    c. Unoccupied
    d. Tenant override
3. Unit operation changeover control
    a. Return air temperature
    b. Space temperature
    c. Network signal
4. Cooling and heating change-over temperature with deadband
5. Cooling discharge air temperature (DAT)
6. Supply reset options
    a. Return air temperature
    b. Outdoor air temperature
    c. Space temperature
    d. Airflow (VAV)
    e. Network signal
    f. External (0-10 vdc)
    g. External (0-20 mA)
7. Temperature alarm limits
    a. High supply air temperature
    b. Low supply air temperature
    c. High return air temperature

8. Lockout control for compressors.
9. Compressor interstage timers
10. Night setback and setup space temperature.
11. Currently time and date
12. Tenant override time
13. Occupied/unoccupied time schedule
14. One event schedule
15. Holiday dates and duration
16. Adjustable set points
17. Service mode
    a. Timers normal (all time delays normal)
    b. Timers fast (all time delays 20 sec)

H. To increase the efficiency of the cooling system the DDC controller shall include a discharge air temperature reset program for part load operating conditions. The discharge air temperature shall be controlled between a minimum and a maximum discharge air temperature (DAT) based on one of the following inputs:

1. Airflow
2. Outside air temperature
3. Space temperature
4. Return air temperature
5. External signal of 1-5 vdc
6. External signal of 0-20 mA
7. Network signal

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest area drain. Install to allow service and maintenance.

B. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Connect supply ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to compressor, coils, and fans.
3. Inspect internal insulation.
4. Verify that labels are clearly visible.
5. Verify that clearances have been provided for servicing.
6. Verify that controls are connected and operable.
7. Verify that filters are installed.
8. Clean condenser coil and inspect for construction debris.
9. Remove packing from vibration isolators.
10. Verify lubrication on fan and motor bearings.
11. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
12. Start unit according to manufacturer's written instructions.

    a. Start refrigeration system.
    b. Do not operate below recommended low-ambient temperature.
    c. Complete startup sheets and attach copy with Contractor's startup report.

13. Inspect and record performance of interlocks and protective devices; verify sequences.
14. Operate unit for an initial period as recommended or required by manufacturer.
15. Calibrate thermostats.
16. Adjust and inspect high-temperature limits.
17. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.

18. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:

    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.

19. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
20. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Return-air volume.
    c. Outdoor-air intake volume.

21. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.

22. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.5 CLEANING AND ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.

B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 237413

SECTION 23 81 26

SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

F. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

D. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

E. Units shall be designed to operate with HCFC-free refrigerants.

1.5 COORDINATION

A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

B. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations specified in Division 07 Section "Roof Accessories."

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year parts, 2^{nd}-5^{th} year compressor parts warranty from date of shipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carrier.
2. Mitsubishi.
3. Trane.
4. Daikin.

2.2 WALL-MOUNTING, EVAPORATOR-FAN COMPONENTS

A. Cabinet: Enameled steel with removable panels on front and ends, and discharge drain pans with drain connection.

B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.

C. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.

D. Fan: Direct drive or ECM fan.

E. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.

F. Filters: Permanent, cleanable.

2.3 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

A. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

1. Compressor Type: Scroll
2. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
3. Refrigerant Charge: R-410A.

C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.

D. Heat Pump Components: Reversing valve and low-temperature air cut-off thermostat.

E. Fan: Aluminum-propeller type, directly connected to motor.

F. Motor: Permanently lubricated, with integral thermal-overload protection.

G. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).

H. Mounting Base: Polyethylene.

2.4 ACCESSORIES

A. Control equipment and sequence of operation are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls."

B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

C. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection, including auto setting.

D. Automatic-reset timer to prevent rapid cycling of compressor.

E. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install ground-mounting, compressor-condenser components on 4-inch- (100-mm-) thick, reinforced concrete base; 4 inches (100 mm) larger on each side than unit. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.

D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Install piping adjacent to unit to allow service and maintenance.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 238126

SECTION 260010 - ELECTRICAL GENERAL REQUIREMENTS

PART 1 – GENERAL

1.01 RELATED REQUIREMENTS

A. The General Provisions, Supplemental General Provisions, Special Provisions, Division 1 Specification Sections and all relevant documents shall form a part of this Division of the Specifications, and shall be incorporated in this Section and each Division 26 Section hereinafter as if repeated verbatim herein. All conditions imposed by these documents shall be applicable to all portions of the work under this Division. Certain specific paragraphs of said references may be referred to hereinafter in this Division. These references are intended to point out specific items to the Contractor, but in no way relieve him of the responsibility of reading and complying with all relevant parts of the entire Specification.

B. The Contractor shall examine and coordinate with all Contract Drawings and Specifications, and all Addenda issued. Failure to comply shall not relieve him of responsibility. The omission of details of other portions of the work from this Division shall not be used as a basis for a request for additional compensation.

C. The specific features and details for other portions of the work related to the construction in progress or to the existing building(s) shall be determined by examination at the site.

1.02 SCOPE OF WORK

A. The requirements contained in this Section apply to all work performed under Division 26 of these Specifications.

B. The work covered by this Division of the Specifications comprises the furnishing of labor, material, equipment, transportation, tools and services, and performing operations required for, and reasonably incidental to, the installation of the work in accordance with the applicable Contract Documents, and subject to the terms and conditions of the Contract.

C. Refer to other Divisions of the Specifications for related work.

1.03 DEFINITION OF "CONTRACTOR"

A. Where the word "Contractor" is used under any Section of this Division of the Specifications, it shall mean the Contractor engaged to execute the work included under that Section.

1.04 RESPONSIBILITY OF THE CONTRACTOR

A. The Contractor shall be responsible for all work of every description in connection with this Division of the Specifications. The Contractor shall specifically and distinctly assume, and does so assume, all risk for damage or injury from whatever cause to property or person used or employed on or in connection with this work and of all damages or injury to any person or property wherever located, resulting from an action or operation under the Contract in connection with the work, and undertake the responsibility to defend the Owner against all claims on account of any such damage or injury.

B. The Contractor will be held responsible for the satisfactory execution and completion of the work in accordance with the true intent of the Contract Documents. The Contractor shall provide without extra charge all incidental items required as part of the work, even though it may not be specifically indicated. If the Contractor has reason for objecting to the use of any material, equipment, device or method of construction as indicated, he shall make report of such objections to the Owner's Representative, obtain proper approval and adjustment to the Contract, and shall proceed with the work.

1.05 TERMINOLOGY

A. Whenever the words "furnish", "provide", "furnish and install", "provide and install", and similar phrases occur, it is the intent that the materials, equipment and devices described be furnished, installed and connected under this Division, complete for operation, unless specifically noted to the contrary.

B. It is also the intent, unless specifically noted to the contrary, that all materials, equipment and devices described and specified under this Division of the Specifications be similarly furnished, installed and connected under this Division, whether or not a phrase as described in the preceding paragraph has been actually included.

1.06 ORDINANCES, PERMITS AND CODES

A. It shall be the Contractor's duty to perform the work and provide the materials covered by these specifications in conformance with all ordinances and regulations of all authorities having jurisdiction.

B. All work herein shall conform to all applicable laws, ordinances and regulations of the local utility companies.

C. The Contractor shall obtain and pay for all permit and connection fees as required for the complete installation of the specified systems, equipment, devices and materials.

D. The Contractor shall obtain permits, plan checks, inspections and approvals applicable to the work as required by the regulatory authorities. Fees and costs of any nature whatsoever incidental to these permits, inspections and approvals shall be assumed and paid by the Contractor. The pro-rata costs, if any, for utilities serving this property will be paid for by the Owner and shall not be included as part of this Contract.

E. The work shall be in accordance with, but shall not be limited to, the requirements of:

1. National Fire Protection Association

2. National Electrical Code

3. National Safety Code

4. State of Texas Safety Code

5. City of La Joya Building Codes

6. State of Texas Building Codes

F. Codes and standards referred to are minimum standards. Where the requirements of the Drawings or Specifications exceed those of the codes and regulations, the Drawings and Specifications govern.

1.07 MATERIALS, EQUIPMENT AND DEVICE DESCRIPTION

A. Materials, equipment and devices shall be of the best quality customarily applied in quality commercial practice, and shall be the products of reputable manufacturers. Each major component shall bear a nameplate giving the name and address of the manufacturer, and the catalog number or designation of the component.

B. Materials, equipment and devices furnished under this Division of the Specifications shall be essentially the standard product of the specified manufacturer, or where allowed, an alternate manufacturer. Where two or more units of the same kind or class of a specific item are required, these shall be the products of a single manufacturer; however, the component parts of the item need not be the products of one manufacturer.

C. In describing the various materials, equipment and devices, in general each item will be described singularly, even though there may be a multiplicity of identical items. Also, where the description is only general in nature, exact sizes, duties, space arrangements, horsepower requirements and other data shall be determined by reference to the Contract Documents.

D. Space allocations for materials, equipment and devices have been made on the basis of present and known future requirements and the dimensions of items of equipment or devices of a particular manufacturer whether indicated or not. The Contractor shall verify that all materials, equipment and devices proposed for use on this project are within the constraints of the allocated space.

1.08 QUALITY ASSURANCE

A. Materials, equipment and devices shall be new and of the quality specified, and shall be free from defects at the time of installation. Materials, equipment and devices damaged in shipment or otherwise damaged or found defective prior to acceptance by the Owner shall not be repaired at the job site, but shall be replaced with new materials, equipment or devices identical with those damaged, unless specifically approved otherwise by the Owner's Representative.

B. Wherever a UL standard has been established for a particular type of material, equipment or device, each item of such material, equipment or device provided on this project shall meet the requirements of the UL standard in every way, and shall be UL listed and labeled.

1.09 REFERENCE STANDARDS

A. Materials, equipment, devices and workmanship shall comply with applicable local, county, state and national codes, laws and ordinances, utility company regulations and industry standards.

B. In case of differences between building codes, state laws, local ordinances, industry standards, utility company regulations and the Contract Documents, the most stringent shall govern. The Contractor shall promptly notify the Owner's Representative in writing of any such difference. Should the Contractor perform any work that does not comply with local codes, laws and ordinances, industry standards or other governing regulations, the work shall be corrected of noncompliance deficiencies with the Contractor bearing all costs.

C. In addition to the aforementioned ordinances, industry standards published by the following organizations shall apply:

AABM-American Association of Battery Manufacturers

AIA-American Institute of Architects

ANSI-American National Standards Institute

ASTM-American Society for Testing and Materials

CBM-Certified Ballast Manufacturers Association

ETL-Electrical Testing Laboratories

FM-Factory Mutual

ICEA-Insulated Cable Engineers Associated

IEEE-Institute of Electrical and Electronic Engineers

IES-Illuminating Engineering Society

IRI-Industrial Risk Insurance

NBS-National Bureau of Standards

NEC-National Electrical Code

NECA-National Electrical Contractors Association

NEMA-National Electrical Manufacturers Association

NESC-National Electrical Safety Code

NETA-National Electrical Testing Association

NFPA-National Fire Protection Association

UL-Underwriters Laboratories

D. Where the Contract Documents exceed the above requirements, the Contract Documents shall govern. In no case shall work be installed contrary to or below the minimum legal standards.

1.10 DRAWINGS AND SPECIFICATIONS

A. The interrelation of the Drawings (including the schedules) and the Specifications are as follows:

1. The Drawings establish quantities, locations, dimensions and details of materials, equipment and devices. The schedules on the Drawings indicate the capacities, characteristics and components.

2. The Specifications provide written requirements for the quality, standard and nature of the materials, equipment, devices and construction systems.

B. The Drawings and Specifications shall be considered as being compatible; therefore, the work called for by one and not by the other shall be furnished and installed as though called for by both. Resolution of conflicts between Drawings and Specifications shall be as follows:

1. If the Drawings and Specifications disagree in themselves, or with each other, the Contractor's pricing shall be based on furnishing and installing the most expensive combination of quality and quantity of work indicated. In the event of this type of disagreement, the resolution shall be determined by the Architect/Engineer.

2. The Contractor shall be responsible for bringing any conflicts in the Drawings and the Specifications to the attention of the Architect/Engineer prior to any work being performed.

3. Materials, equipment and devices called for on the Drawings and not indicated herein, shall be completely provided and installed as though it were fully described herein.

4. Materials, equipment and devices called for herein shall be completely provided and installed, whether or not it is fully detailed, scheduled or indicated on the Drawings.

C. The Contractor shall examine the Drawings and Specifications of the other portions of the work for fixtures and finishes in connection with this work. The Contractor shall carefully examine the Drawings to determine the general construction conditions, and shall familiarize himself with all limitations caused by such conditions.

D. When discrepancies exist between scale and dimension, or between the Drawings of the various portions of the work, they shall be called to the attention of the Architect/Engineer for further instruction, whose instructions shall be final and binding and work promptly resumed without any additional cost to the Owner.

E. Review the construction details of the building(s) as illustrated on the Drawings of the various portions of the work and be guided thereby. Route conduits and set all boxes as required by the pace of the general construction.

F. The Drawings diagrammatically show the sizes and locations of the various equipment and devices, and the sizes of the major interconnecting wires, without showing exact details as to elevations, offsets, control wiring

and other installation requirements. Carefully layout the work at the site to conform to the architectural and structural conditions, to avoid obstructions and to permit proper grading of pipe associated with other portions of the work. Determine the exact location of equipment and devices and connections thereto by reference to the submittals and rough-in drawings, and by measurements at the site. Make minor relocations necessitated by the conditions at the site, or directed by the Architect/Engineer, without additional cost to the Owner.

G. The Drawings and Specifications are intended to describe and illustrate systems which will not interfere with the structure of the building(s), fit into the available spaces, and insure complete and satisfactory operating installations. Prepare installation drawings for all critical areas illustrating the installation of the work in this Division as related to the work of all other Divisions and correct all interferences with the other portions of the work or with the building structures before the work proceeds.

H. The Drawings do not indicate the existing electrical installations other than to identify modifications or extensions thereto. Visit the site and ascertain the conditions to be met and the work to be accomplished in removing and modifying the existing work, and in installing the new work. Failure to comply with this shall not constitute grounds for any additional payment in connection with removing or modifying any part of the existing installation or installing any new or temporary work under this Division.

1.11 SHOP DRAWINGS AND SUBMITTAL DATA

A. Process shop drawings and submittal data to insure that the proposed materials, equipment and devices conform to the requirements of the Contract Documents, and that there are no omissions or duplications. Provide layouts, fabrication information and data for systems, materials, equipment and devices proposed for the project.

B. Shop drawings shall be drawn on a scale not less than 1/4 inch equals 1 foot showing actual dimensions. Shop drawings shall include, but not be limited to:

1. Switchboard

2. Distribution Panelboards

3. Lighting/Appliance Panelboards

C. Submittal data (manufacturer's catalog data) shall include, but not be limited to:

1. Equipment: switchboard, panelboards, transformers, disconnect switches, circuit breakers, fuses, etc.

2. Materials: conduit, conductors, connectors, supports, etc.

3. Lighting fixtures and lamps.

4. Wiring devices.

5. All Specification sections requiring electrical submittals.

D. The submittal data shall not consist of manufacturer's catalogs or cut sheets that contain no indication of the exact item offered. The submission on individual items shall designate the exact item offered.

E. Do not submit detailed quantitative listings of materials, equipment and devices. It is the Contractor's responsibility to provide proper sizes and quantities to conform with Contract Documents.

F. Assemble submittals on related items procured from a single manufacturer in a 3 ring binder with each section identified by Specification Section by tabbed divider rather than submitting a multiplicity of loose or stappled sheets. On the end of the binder and on the front cover the Project Title shall be typed neatly and readily visible when placed in a storage shelf. Submittals not identified by specification section, and incomplete, will

be returned to contractor without review for resubmittal.

G. The Contractor shall submit shop drawings whenever equipment proposed varies in physical size and arrangement from that indicated thus causing rearrangement of equipment space, where tight spaces require extreme coordination between this work and other work, where called for elsewhere in these Specifications and where specifically requested by the Architect/ Engineer. Shop drawings shall be prepared at a scale of not less than 1/4 inch equals 1 foot.

1.12 SUBSTITUTIONS

A. Where a single manufacturer is mentioned by trade name or manufacturer's name, unless specifically noted otherwise, it is the only manufacturer that will be accepted.

B. Where multiple manufacturers are listed, none other than those manufacturers will be accepted.

C. It shall be understood that space allocations have been made on the basis of present and known future requirements and the dimensions of items of equipment or devices of a particular manufacturer whether indicated or not. If any item of equipment or device is offered in substitution which differs substantially in dimension or configuration from that indicated on the Drawings or specifications, provide as part of the submittal 1/4 inch equals 1 foot scaled drawings showing that the substitute can be installed in the space available without interfering with other portions of the work or with access for operations and maintenance in the completed project.

D. Where substitute equipment or devices requiring different arrangement or connections from that indicated is accepted by the Architect/Engineer, install the equipment or devices to operate properly and in harmony with the intent of the Contract Documents, making all incidental changes in piping, ductwork or wiring resulting from the equipment or device selection without any additional cost to the Owner. The Contractor shall pay all additional costs incurred by other portions of the work in connection with the substituted equipment or device.

E. The Architect/Engineer reserves the right to call for samples of any item of material, equipment or device offered in substitution, together with a sample of the specific item when, in their opinion, the quality of the item and/or the appearance is involved, and it is deemed that an evaluation of the item may be better made by visual inspection.

F. When any request for a substitution of material, equipment or device is submitted and rejected, the item named in the Contract Documents shall be furnished. Repetitive submittal of substitutions for the same item will not be considered.

1.13 INSTALLATION DRAWINGS

A. Prepare installation drawings for coordinating the work of this Division with the work of other Divisions, to illustrate its concealment in finished spaces, to avoid obstructions, and to demonstrate the adaptability of any item of material, equipment or device in the space upon which the Contract Documents are based.

B. Use these drawings in the field for the actual installation of this work. Provide three (3) copies, not for approval, to the Architect/Engineer for his information, review and record.

1.14 WORKMANSHIP AND INSTALLATION

A. In no case shall the Contractor provide a class of material, equipment, device or workmanship less than that required by the Contract Documents or applicable codes, regulations, ordinances or standards. All modifications which may be required by a local authority having legal jurisdiction over all or any part of the work shall be made by the Contractor without any additional charge. In all cases where such authority requires deviations from the requirements of the Drawings or Specifications, the Contractor shall report same to the Owner's Representative and shall secure his approval before the work is started.

B. The work shall be performed by properly licensed technicians skilled in their respective trades. All materials, equipment and devices shall be installed in accordance with the recommendations of the manufacturer and in the best standard practice to bring about results of a first class condition.

C. The NECA "Standards of Installation" as published by the National Electrical Contractors Association shall be considered a part of these Specifications, except as specifically modified by other provisions contained in these Specifications.

1.15 WARRANTY

A. All materials, equipment, devices and workmanship shall be warranted for a period of one year from the date of acceptance by the Architect/Engineer for beneficial use by the Owner, except that where specific equipment is noted to have extended warranties. The warranty shall be in accordance with AIA Document A201. The Contractor shall be responsible for the proper registration of these warranties so that the Owner can make all proper claims should future need develop.

B. The Contractor shall furnish to the Architect/Engineer for transmittal to the Owner, the name, address and telephone number of those persons responsible for service on systems and equipment covered by the warranty.

1.16 OPERATION PRIOR TO ACCEPTANCE

A. When any equipment is operable, and it is to the advantage of the Contractor to operate the equipment, the Contractor may do so provided that he properly supervises the operation, and retains full responsibility for the equipment operated. Regardless of whether or not the equipment has or has not been operated, the Contractor shall clean the equipment properly, make required adjustments and complete punch list items before final acceptance by the Owner.

1.17 INSTRUCTION OF OWNER'S PERSONNEL

A. Provide the services of competent engineers and/or technicians acceptable to the Architect/ Engineer to instruct other representatives of the Owner in the complete and detailed operation of each item of equipment or device of all the various electrical systems. These instructions shall be provided for whatever periods may be necessary to accomplish the desired results. Upon completion of these instructions, the Contractor shall obtain a letter of release, acknowledged by the Owner or his authorized representative, stating the dates on which the various kinds of instruction were given, and the personnel to whom the instructions were given.

B. The Contractor shall be fully responsible for proper maintenance of equipment and systems until the instructions have been given to the Owner's personnel and the letter of release acknowledged.

C. In providing the instructions to the Owner's personnel, the written operating and maintenance manuals shall be followed in all instances, and the Owner's personnel shall be familiarized with such manuals. Operating and maintenance manuals used for instructions shall include wiring diagrams, manufacturer's operating and maintenance instructions, parts lists (with sources identified), and other data as appropriate for each system.

1.18 SCHEDULE AND SEQUENCE OF WORK

A. The Contractor shall meet and cooperate with the Owner and Architect/Engineer to schedule and sequence this work so as to insure meeting scheduled completion dates and avoid delaying other portions of the work. Work requiring special sequencing shall be at no additional cost to the Owner and shall have no impact on the schedule.

1.19 INSPECTIONS AND CERTIFICATIONS

A. Obtain timely inspections of the installation by the regulatory authorities. Remedy any deficiencies to the satisfaction of the inspecting official.

B. Upon final completion of the work, obtain certificates of acceptance from the regulatory authorities. Deliver the certificates to the Architect/Engineer for transmission to the Owner.

1.20 EQUIPMENT INSTALLATION

A. Install equipment and devices in a manner to permit access to all surfaces or components, requiring such access, without the need to disassemble other unrelated parts of the work.

B. Equipment specified to be factory assembled and tested prior to shipment shall not be disassembled at the job site and reassembled at its final location. Apparatus not so specified may be disassembled and reassembled in the proper location.

C. Furnish all scaffolding, rigging and hoisting required for the installation of all the work.

D. Large equipment assemblies and components which will be installed in the building, and which are too large to permit access through doorways, stairways or shafts, shall be brought to the site and placed in the appropriate spaces before the enclosing structure is complete.

1.21 EQUIPMENT FOUNDATIONS

A. Where indicated on the Drawings, provide foundations for electrical equipment. This shall consist of concrete housekeeping pads constructed in accordance with the details on the Drawings, these Specifications, manufacturer's recommendations and Division 3.

B. All pad, unless noted otherwise, shall be 4" high and extend a maximum 2" beyond the actual equipment size. Coordinate the proper size of the pad with the equipment furnished. Furnish all anchor bolts and other accessories required for casting the concrete pad. After the equipment is set on the pad, the equipment shall be fully grouted to the pad and all void spaces shall be filled with a non-shrinking grout.

1.22 SLEEVES

A. Each conduit, regardless of material, which passes through a concrete slab, masonry wall, or roof or portion of the building structure shall be free from the structure and shall pass through a sleeve.

B. All sleeves shall be constructed from electrical-metallic tubing or equivalent weight galvanized steel tubing and shall be flush on both sides of the surface penetrated, unless noted otherwise. All sleeves penetrating the roof areas shall extend a minimum 10 inches above the roof with approved weatherproof counterflashing attached to the conduit above the roof. All sleeves penetrating floors shall extend a minimum of 6 inches above the finished floors. The sleeves shall be sized to allow free passage of the conduit to be inserted.

C. Sleeves passing through walls or floors on or below grade or in moist areas shall be constructed of galvanized rigid steel and shall be designed with a suitable flange in the center to form a waterproof passage. After the conduit has been installed in the sleeves, the void space around the conduit shall be caulked with jute twine and filled with an asphalt-base compound to insure a waterproof penetration.

1.23 ESCUTCHEONS

A. In each finished space, provided a chromium plated, sectional escutcheon on each conduit, or hanger rod penetrating a wall, floor or ceiling.

B. Size escutcheons and collars to fit snugly around conduit and rods.

C. Where required, provide escutcheons with set screws so that they fit snugly against the finished surface.

1.24 ACCESS PANELS

A. Provide wall and ceiling access panels for unrestricted access to all concealed electrical equipment items and

devices installed behind furrings, chases or non-removable suspended ceilings.

B. Access panels shall be UL listed and labeled as required to suit the fire rating of the surface in which installed, with mounting straps, concealed hinges, screwdriver locks, 180 degree open door design, 16 gauge steel construction and door and frame finished in prime coat finish. Panels shall be 12-inch by 12-inch minimum size, but shall be larger as the access requirement of the concealed electrical equipment item or device increases.

1.25 EXCAVATION, TRENCHING AND BACKFILLING

A. All excavating, trenching and backfilling shall generally be performed in accordance with the procedures and using the materials as described in Division 2. Provide all excavation required in connection with the installation of the work under this Division. After the work has been installed, tested and approved, backfill all excavations with suitable material.

B. Bottoms of trenches shall be cut to grade. Should rock be encountered, same shall be excavated to a depth of six (6) inches below bottom of conduit and space shall be filled and tamped as specified hereinafter. Should it be required to lay conduit on fill, fill shall first be compacted.

C. All conduit shall be installed promptly after excavation has been done so as to keep excavations open as short a time as possible.

D. Trenches shall be excavated to the required depths. Depth of cover shall be as required by the NEC or as indicated on Drawings. Keep banks of trenches as nearly vertical as possible, and provide adequate shoring where required.

E. When excavation is below the shale or subgrade level, backfill with granular fill or approved backfill material from the site to a depth of 12 inches above top of conduit, but in no case less than 1'-0" below the subgrade surface. The remainder of backfill to the shale or subgrade surface shall be an impervious material and shall be compacted at not less than 95 percent of the maximum dry density as defined by ASTM D-698. At all times, the top of the subgrade shall be kept in such condition that it will drain readily and effectively. A mud slab shall be placed over excavation where required by the Drawings or Specifications. Backfill above the subsurface shall be granular fill or approved select backfill from site.

F. Beyond building walls or above the shale or subgrade level, backfill with sand or granular fill to a depth of 12 inches above top of conduit and remainder of trench filled with approved select backfill material from the site.

G. Bottoms of trenches shall be tamped hard and graded to secure the maximum fall. Where rock is excavated below the bottom of the conduit, and before laying the conduit, fill the space between the bottom of the conduit and the rock surface with sand, thoroughly tamped.

H. Trenches dug in fill shall have the conduit supported down to load-bearing soil. After conduits have been inspected and approved by the Owner's Representative, trenches shall be filled with approved backfill material which shall be firmly compacted, flooded if necessary and thoroughly tamped. Do not backfill with any fill containing rocks, frozen earth or debris.

I. Include the cutting of all sidewalks, streets and other pavements and repairing the openings in them to return the surface to approximately its original condition.

1.26 CUTTING AND PATCHING

A. Cut all openings required to install the work or to repair any defective work. This cutting shall be performed under the Architect's/Engineer's direction and due diligence exercised to avoid cutting openings larger than required or in the wrong locations.

B. No cutting or drilling of any sort will be permitted in the webs of prestressed, precast concrete structural

elements. Use core drills or power driven saws to cut openings in the flanges of other such elements; the use of reciprocating drills will not be permitted. The cutting of structural members without first having received written permission from the Architect/ Engineer is prohibited.

C. Where openings are cut in fire-rated walls or floors, seal the annular space between the work installed and the fire-rated construction. Sealant, as applied, shall be fire rated to maintain the fire rating of the construction penetrated. Sealant shall be re-enterable (before fire) to alter penetrations. Apply in strict accordance with manufacturer's instructions.

1.27 SEALING OF PENETRATIONS

A. All penetrations in horizontal or vertical fire-rated construction shall be sealed using approved fire-rated sealing materials equivalent to the following:

1. Foam: Dow Corning 3-6548 RTV silicone foam, liquid component Part 4 (black) and liquid component Part B (off-white).

2. Sealant: Dow Corning 96-081 RTV silicone adhesive sealant.

3. Damming Materials: Mineral fiberboard, mineral fiber matting, mineral fiber putty, plywood or particle board, as selected by applicator.

B. Preparation: Remove combustible materials and loose impediments from penetration opening and involved surfaces. Remove free liquid and oil from penetration surfaces.

C. Installation: In accordance with manufacturer's instructions, install damming materials and sealant to cover and seal penetration openings; inject foam mixtures into openings.

1.28 PROTECTION OF APPARATUS

A. At all times take every precaution to properly protect apparatus from damage due to dust, dirt, water, etc. or from damage due to physical forces. Include the erection of temporary shelters as required, to adequately protect any apparatus stored at the site, the cribbing of any apparatus directly above the construction, and the covering of apparatus in the incomplete building with tarpaulins or other protective covering. Failure on the part of the Contractor to comply with the above to the entire satisfaction of the Architect/Engineer will be sufficient cause for the rejection of the pieces of apparatus in question.

B. Responsibility for the protection of apparatus extend also to existing apparatus involved in this Division of the work, whether such apparatus is designated to be used temporarily and later removed, or is to be reused as a part of the permanent installation. Erect temporary sheltering structures, provide temporary bracing and supports, or cover equipment as required or directed to afford proper protection for that equipment.

C. The Contractor shall protect this work and the work of all other Contractors from damage by his work or workmen and shall make good any damage thus caused. He shall also be responsible for the proper protection of his equipment, machinery, materials and accessories delivered and installed on the job.

1.29 INSTALLATION AND CONNECTION OF OTHER DIVISION'S EQUIPMENT

A. Verify the electrical requirements of all equipment furnished under other Divisions, separate contracts, or by the Owner. Install conduit, power wiring, control wiring, devices, etc. as required for complete operation of all equipment.

1.30 OPTION TO RELOCATE OUTLETS AND RELATED DEVICES

A. The location of power, data and telephone outlets, wall switches and other related devices may be relocated at the Owner's option, at no additional cost to the Owner, to a point within 10 feet of their present location

provided the Contractor is notified prior to installation.

1.31 COOPERATION AND CLEAN-UP

A. It shall be the responsibility of the Contractor to cooperate fully to keep the job site in a clean and safe condition. Upon the completion of the job, the Contractor shall immediately remove all of his tools, equipment, surplus materials and debris.

B. After the installation is complete, and before the equipment is energized, clean the interior and exterior of all equipment thoroughly. Clean equipment, removing all debris, rubbish and foreign materials. Each component shall be cleaned and all dust and other foreign material removed. Components shall be cleaned of oxidation. The inside and outside of all switchgear shall also be wiped clean with a lemon-oil rag after all other cleaning is complete.

C. Any portion of the work requiring touch-up finishing shall be so finished to equal the specified finish on the product.

1.32 RECORD DRAWINGS AND DOCUMENTATION FOR OWNER

A. The Contractor shall obtain at his own expense a complete set of blueline prints on which to keep an accurate record of the installation of all materials, equipment and devices covered by the Contract. The record drawings shall indicate the location of all equipment and devices, and the routing of all systems. All piping and conduit buried in concrete slabs, walls and below grade shall be located by dimension; both horizontally and by vertical elevation, unless a surface mounted device in each space indicates the exact location. Obtain one complete reproducible set of the original drawings on which to neatly, legibly and accurately transfer all project related notations and deliver these drawings to the Architect/Engineer at job completion before final payment and delivery to the Owner. The above data, with the exception of the record drawings, shall be delivered prior to final acceptance.

B. The Contractor shall accumulate in duplicate during the job progress, the following data prepared in indexed 3-ring looseleaf, hard-back binders sized for 8-1/2 inch by 11 inch sheets. No binder shall exceed 3-1/2 inches thick. This data shall be turned over to the Architect/Engineer for review and subsequent delivery to the Owner prior to final acceptance.

1. Warranties, guarantees and manufacturer's directions on material, equipment and devices covered by the Contract.

2. Approved lighting fixture brochures, wiring diagrams and control diagrams.

3. Copies of approved submittals and shop drawings.

4. Operating instructions for major apparatus and recommended maintenance procedures.

5. Copies of all other data and/or drawings required during construction.

6. Repair parts list of major apparatus, including name, address and telephone number of local supplier or representative.

7. Tag charts and diagrams hereinbefore specified.

1.33 FINAL OBSERVATION

A. The purpose of the final observation is to determine whether the Contractor has completed the construction in accordance with the Contract Documents and that in the Owner Representative's opinion the installation is satisfactory for final acceptance by the Owner.

B. It shall be the responsibility of the Contractor to assure that the installation is ready for final acceptance prior to calling upon the Architect/Engineer to make a final observation.

END OF SECTION 260010

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.

B. Related Sections include the following:

C.
   1. Section 271500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alcan Products Corporation; Alcan Cable Division.
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.
6. Encore.

C. Copper Conductors: Comply with NEMA WC 70.

D. Conductor Insulation: Comply with NEMA WC 70 for Types THW THHN-THWN and SO.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

E. Feeders Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.

F. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

I. Branch Circuits Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.

J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

K. Class 1 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.7 FIELD QUALITY CONTROL

A. Torque test conductor connections and terminations to manufacturer's recommended values.

B. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

C. Conductors in vertical conduits or raceways shall be supported in the manner set forth in the appropriate section of the latest revision of the National Electrical Code. Lighting fixtures shall not be used for raceways for circuits other than parallel wiring of fixtures.

D. Conductors may be run in parallel on sizes 1/0 to 500 MCM inclusive provided all paralleled conductors are the same size, length, and type of insulation. Except as otherwise shown on drawings, no more than three conductors may be run in parallel, and they shall be so arranged and terminated as to insure equal division of the total current between all conductors involved. Where parallel connection is contemplated, approval of the Owner's representative must be obtained before installation is made.

3.8 TESTING AND ACCEPTANCE

A. Before final acceptance, the Contractor shall make voltage, insulation, and load tests, necessary to demonstrate to the Owner's representative the satisfactory installation and proper performance of all circuits.

B. Test feeder conductors clear of faults. Insulation-resistance test shall be conducted per NETA – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems. Test results below 50 megohms shall be cause for rejection of the wiring installation. Replace and retest all such rejected conductor.

C. At the completion of this project, the Contractor shall provide for the Owner three (3) complete and finally corrected sets of working drawings. These sets of working drawings shall be new, unused and in good condition, and shall include the nature, destination, path, size and type of wire and all other characteristics for complete identification of each and every conduit and circuit.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Grounding systems and equipment.

B. Section includes grounding systems and equipment, plus the following special applications:
   1. Underground distribution grounding.
   2. Ground bonding common with lightning protection system (where specified).

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
   1. Test wells.
   2. Ground rods.
   3. Grounding arrangements and connections for separately derived systems.
   4. Grounding for sensitive electronic equipment.

C. Qualification Data: For qualified testing agency and testing agency's field supervisor.

D. Field quality-control reports.

E. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. Instructions for periodic testing and inspection of grounding features at test wells grounding connections for separately derived systems.
      a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
      b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: [Copper] [or] [tinned-copper] wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, [1/4 by 4 inches (6.3 by 100 mm)] in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.2 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel, 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
   1. Bury at least 24 inches (600 mm) below grade.
   2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Install bus on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
   2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.

E. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.
   4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeders and branch circuits.
   2. Lighting circuits.
   3. Receptacle circuits.
   4. Single-phase motor and appliance branch circuits.
   5. Three-phase motor and appliance branch circuits.
   6. Flexible raceway runs.
   7. Armored and metal-clad cable runs.
   8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
   9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
   10. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

G. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.
   1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
   2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch (6.3-by-100-by-300-mm) grounding bus.
   3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

H. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
   2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:
   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
   2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
   3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install [tinned]bonding jumper to bond across flexible duct connections to achieve continuity.

F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

G. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
   1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
   2. Bury ground ring not less than 24 inches (600 mm) from building's foundation.

3.5 LABELING

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer[and at the grounding electrode conductor where exposed].
   1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
   3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
      a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
      b. Perform tests by fall-of-potential method according to IEEE 81.
   4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Report measured ground resistances that exceed the following values:
   1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
   2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
   3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
   4. Power Distribution Units or Panelboards Serving Electronic Equipment 3 ohm(s).
   5. Manhole Grounds: 10 ohms.

E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Steel slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
   1. Trapeze hangers. Include Product Data for components.
   2. Steel slotted channel systems. Include Product Data for components.
   3. Equipment supports.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.; a division of Cooper Industries.
      c. ERICO International Corporation.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation.
      f. Unistrut; Tyco International, Ltd.
   2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   4. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Hilti Inc.
2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type, steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Cooper B-Line, Inc.; a division of Cooper Industries.
2) Hilti Inc.
3) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners or threaded through wall.
   5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
   6. To Steel: Beam clamps complying with MSS SP-69.
   7. To Light Steel: Sheet metal screws.
   8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.
   1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor bolts to elevations required for proper attachment to supported equipment.
   3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Division 09 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:
   1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. FMC: Flexible metal conduit.

D. IMC: Intermediate metal conduit.

E. LFMC: Liquidtight flexible metal conduit.

F. NBR: Acrylonitrile-butadiene rubber.

G. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
   1. Custom enclosures and cabinets.
   2. For handholes and boxes for underground wiring, including the following:
      a. Duct entry provisions, including locations and duct sizes.
      b. Frame and cover design.
      c. Grounding details.
      d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
      e. Joint details.

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Structural members in the paths of conduit groups with common supports.
   2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AFC Cable Systems, Inc.
   2. Alflex Inc.
   3. Allied Tube & Conduit; a Tyco International Ltd. Co.
   4. Anamet Electrical, Inc.; Anaconda Metal Hose.
   5. Electri-Flex Co.
   6. Manhattan/CDT/Cole-Flex.
   7. Maverick Tube Corporation.
   8. O-Z Gedney; a unit of General Signal.
   9. Wheatland Tube Company.

C. Rigid Steel Conduit: ANSI C80.1.

D. IMC: ANSI C80.6.

E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
   1. Comply with NEMA RN 1.
   2. Coating Thickness: 0.040 inch (1 mm), minimum.

F. EMT: ANSI C80.3.

G. FMC: Zinc-coated steel

H. LFMC: Flexible steel conduit with PVC jacket.

I. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
   1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
   2. Fittings for EMT: Steel -screw or compression type.

3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

J. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. CANTEX Inc.
4. CertainTeed Corp.; Pipe & Plastics Group.
5. Lamson & Sessions; Carlon Electrical Products.
6. RACO; a Hubbell Company.
7. Thomas & Betts Corporation.

C. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

D. LFNC: UL 1660.

E. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

F. Fittings for LFNC: UL 514B.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Arnco Corporation.
2. Endot Industries Inc.
3. IPEX Inc.
4. Lamson & Sessions; Carlon Electrical Products.
5.

C. Description: Comply with UL 2024; flexible type, approved for plenum installation.

2.4 METAL WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.

2. Hoffman.
3. Square D; Schneider Electric.
4. Wiremolp.
5. Cabolafil.

C. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1 or 3R, unless otherwise indicated.

D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

E. Wireway Covers: As indicated.

F. Finish: Manufacturer's standard enamel finish.

2.5 SURFACE RACEWAYS: (As indicated on drawings)

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Thomas & Betts Corporation.
b. Walker Systems, Inc.; Wiremold Company (The).
c. Wiremold Company (The); Electrical Sales Division.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Butler Manufacturing Company; Walker Division.
b. Hubbell Incorporated; Wiring Device-Kellems Division.
c. Lamson & Sessions; Carlon Electrical Products.
d. Panduit Corp.
e. Walker Systems, Inc.; Wiremold Company (The).
f. Wiremold Company (The); Electrical Sales Division.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.

11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular. (As indicated on drawings)

F. Nonmetallic Floor Boxes: Nonadjustable, round.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

I. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic or fiberglass.

J. Cabinets:
1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.
1. Color of Frame and Cover: Gray.
2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC." or "Data/Comm"
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
a. Armorcast Products Company.
b. Carson Industries LLC.

c. CDR Systems Corporation.
d. NewBasis.
e. Highline

C. Fiberglass Handholes and Boxes with Polymer-Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester-resin enclosure joined to polymer-concrete top ring or frame.
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
a. Armorcast Products Company.
b. Carson Industries LLC.
c. Christy Concrete Products.
d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
e. Highline.

D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of hot-dip galvanized-steel diamond plate.
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
a. Carson Industries LLC.
b. Christy Concrete Products.
c. Nordic Fiberglass, Inc.
d. Highline.

2.8 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.9 SLEEVE SEALS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Carbon steel Include two for each sealing element.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
   1. Exposed Conduit: Rigid steel conduit.
   2. Concealed Conduit, Aboveground: EMT
   3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
   4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
   5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
   6. Application of Handholes and Boxes for Underground Wiring:
      a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
      b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.
      c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.

B. Comply with the following indoor applications, unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage: EMT.
   2. Exposed, Not Subject to Severe Physical Damage: EMT.
   3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
      a. Loading dock.
      b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
      c. Mechanical rooms.
   4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
   6. Damp or Wet Locations: Rigid steel conduit.
   7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT or cable tray. All conduits shall have plastic bushing at the ends.
   8. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: EMT
   9. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable EMT.
   10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations. HUBS to match conduit.

C. Minimum Raceway Size: 1/2-inch.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
   2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation. Use conduit caps to protect installed conduit against entrance of dirt and moisture before area is dryed in and cable or wire are not immediately installed. Tape covering of conduit ends is not acceptable.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Raceways Embedded in Slabs:
   1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
   2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
   3. Change from Type EPC-40-PVC to rigid steel conduit, before rising above the floor.
   4. Elbows larger than 1/2" or on runs longer than 50' shall be rigid steel.
   5. Tape all GRC with 2" overlapping tape where underground or where in contact with concrete.

I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
   1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
   2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
   3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where otherwise required by NFPA 70.

N. Expansion-Joint Fittings: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m).
   1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
      a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C temperature change.
      b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
      c. Indoor Spaces: Connected with the Outdoors without Physical Separation: [125 deg F (70 deg C) temperature change.
      d. Attics: 135 deg F (75 deg C) temperature change.
   2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change.
   3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
   4. Unless expansion fitting has internal bonding braid, a green insulated grounding conductor shall be pulled in conduit.

O. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
   1. Use LFMC in damp or wet locations subject to severe physical damage.
   2. Use LFMC in damp or wet locations not subject to severe physical damage.

P. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

Q. Set metal floor boxes level and flush with finished floor surface.

R. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:
   1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
   2. Install backfill as specified in Division 31 Section "Earth Moving."
   3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
   4. Install manufactured elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
   5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
      a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.

b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes and boxes with bottom below the frost line, below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:
   1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
   2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.8 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
   2. Sleeve-seal systems.
   3. Sleeve-seal fittings.
   4. Grout.
   5. Silicone sealants.

B. Related Requirements:
   1. Division 07 Section "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:
   1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
   2. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:
   1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.

2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:
1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:
   a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
   b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating; of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.4 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
   1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
   2. Sealant shall have VOC content of less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
   1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
      a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
      b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
   3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
   4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
   5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
   1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
   2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

F. Write-On Tags: Polyester tag, [0.010 inch (0.25 mm)] [0.015 inch (0.38 mm)] <Insert dimension> thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
   1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
   2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 FLOOR MARKING TAPE

A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.3 UNDERGROUND-LINE WARNING TAPE

A. Tape:
   1. 3.5 mils and 6” wide.
   2. Printing on tape shall be permanent and shall not be damaged by burial operations.
   3. Polyethylene tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:
   1. Inscriptions for Red-Colored Tapes: BURIED ELECTRIC LINE, CAUTION.
   2. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

2.4 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:
   1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
   2. 1/4-inch (6.4-mm) grommets in corners for mounting.
   3. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Metal-Backed, Butyrate Warning Signs:
   1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
   2. 1/4-inch (6.4-mm) grommets in corners for mounting.
   3. Nominal size, 10 by 14 inches (250 by 360 mm).

E. Warning label and sign shall include, but are not limited to, the following legends:
   1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
   2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.5 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
   1. Engraved legend with [black letters on white face] <Insert colors>.
   2. Punched or drilled for mechanical fasteners.
   3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

2.6 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

E. Stenciled Legend: In nonfading, waterproof, [black] <Insert color> ink or paint. Minimum letter height shall be [1 inch (25 mm)] <Insert dimension>.

2.7 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
   1. Minimum Width: 3/16 inch (5 mm).
   2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
   3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
   4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
   1. Minimum Width: 3/16 inch (5 mm).
   2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
   3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
   4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
   1. Minimum Width: 3/16 inch (5 mm).
   2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
   3. UL 94 Flame Rating: 94V-0.
   4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
   5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Secure plastic name plates to equipment fronts using screws or rivets. Use of adhesive shall be per owner's approval only.

E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

F. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
   1. Outdoors: UV-stabilized nylon.

2. In Spaces Handling Environmental Air: Plenum rated.

G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches (400 mm) overall.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than A, and [120] V to ground: Identify with self-adhesive vinyl tape applied in bands. Install labels at 10-foot (3-m)] [30-foot (10-m) maximum intervals.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
1. Emergency Power – White letters on Red background.
2. Normal Power – White letters on Black background.
3. UPS – White letters on Orange background.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
   a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
   b. Colors for 208/120-V Circuits:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Neutral: White.
   c. Colors for 480/277-V Circuits:
      1) Phase A: Brown.
      2) Phase B: Orange. (Purple)
      3) Phase C: Yellow.
      4) Neutral: Gray.
   d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

D. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
1. Limit use of underground-line warning tape to direct-buried cables.

2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

G. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
   a. Power transfer switches.
   b. Controls with external control power connections.

I. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.

K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
   a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
   c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
   d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
2. Equipment to Be Labeled:
   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
   b. Enclosures and electrical cabinets.
   c. Access doors and panels for concealed electrical items.
   d. Switchgear.
   e. Switchboards.
   f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
   g. Emergency system boxes and enclosures.
   h. Motor-control centers.
   i. Enclosed switches.
   j. Enclosed circuit breakers.
   k. Enclosed controllers.
   l. Variable-speed controllers.

m. Push-button stations.
n. Power transfer equipment.
o. Contactors.
p. Remote-controlled switches, dimmer modules, and control devices.
q. Battery-inverter units.
r. Battery racks.
s. Power-generating units.
t. Monitoring and control equipment.
u. UPS equipment.

3. Nameplate Detail:
   a. For circuit breakers, panelboards, switchboards, disconnect switches, motor starters, and contactors: ¼-inch letters, identify source to and device load serves, including location.
4. Enclosure Color Coding:
   a. The following systems shall have each junction and pull box cover completely painted per the following:

System	Color of Box Cover
Ethernet Backbone	Blue
Telecommunications	Brown
FCMS	Green
Emergency Power	Red
Security**	White
Fire Alarm	Yellow
Clock	Fluorescent Violet
U.P.S.	Fluorescent Pink

   b. **Security shall include, but not be limited to, the following systems:
      - Card Access
      - Duress Alarms
      - Perimeter Door Alarms
      - CCTV

END OF SECTION 260553

SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.

1.3 SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

C. Qualification Data: For coordination-study specialist.

D. The following submittals shall be made concurrent with the approval for system protective devices. Submittals shall be in digital form and hard copy.
   1. Coordination-study input data, including completed computer program input data sheets.
   2. Study and Equipment Evaluation Reports.
   3. Coordination-Study Report.
   4. Completed power company transformer form.

1.4 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
   1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Computer Software Developers: Subject to compliance with requirements, provide products by one of the following:
   1. CGI CYME.
   2. EDSA Micro Corporation.
   3. ESA Inc.
   4. Operation Technology, Inc.
   5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
   1. Optional Features:
      a. Arcing faults.
      b. Simultaneous faults.
      c. Explicit negative sequence.
      d. Mutual coupling in zero sequence.
      e. Voltage drop and voltage dip.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
   1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices shall be concurrent with submitted and approved coordination study.

3.2 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:
   1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Impedance of utility service entrance. Utility transformer size and impedance are typically obtained from the actual serving utility engineer.

3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
   a. Circuit-breaker and fuse-current ratings and types.
   b. Relays and associated power and current transformer ratings and ratios.
   c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and/or X/R ratios.
   d. Generator kilovolt amperes, size, voltage, and source impedance.
   e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
   f. Busway ampacity and impedance.
   g. Motor horsepower and code letter designation according to NEMA MG 1.
4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
   a. Special load considerations, including starting inrush currents and frequent starting and stopping.
   b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
   c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
   d. Voltage dip for largest motor based on utility transformer and system layout. Advise engineer if dip is greater than 5%.
   e. Generator thermal-damage curve.
   f. Ratings, types, and settings of utility company's overcurrent protective devices.
   g. Special overcurrent protective device settings or types stipulated by utility company.
   h. Time-current-characteristic curves of devices indicated to be coordinated.
   i. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
   j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
   1. Switchgear and switchboard bus.
   2. Medium-voltage controller.
   3. Motor-control center.
   4. Distribution panelboard.
   5. Branch circuit panelboard.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 242.
   1. Transformers:
      a. ANSI C57.12.10.
      b. ANSI C57.12.22.
      c. ANSI C57.12.40.

d. IEEE C57.12.00.
e. IEEE C57.96.
2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
3. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:
1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
2. Show interrupting (5-cycle) and time-delayed currents assess the sensitivity of overcurrent relays and devices.

F. Equipment Evaluation Report:
1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY AND VOLTAGE DIP STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
3. Calculate the maximum and minimum ground-fault currents.

B. Comply with IEEE 241 recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:
1. Device shall not operate in response to the following:
a. Inrush current when first energized.
b. Self-cooled, full-load current or forced-air-cooled, specified for that transformer.
c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Motors served by system shall be reviewed for voltage dip. Report shall verify dip on start is less than 5%.

E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
a. Device tag.

b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
d. Fuse-current rating and type.
e. Ground-fault relay-pickup and time-delay settings.

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
   a. Device tag.
   b. Voltage and current ratio for curves.
   c. Three-phase and single-phase damage points for each transformer.
   d. No damage, melting, and clearing curves for fuses.
   e. Cable damage curves.
   f. Transformer inrush points.
   g. Maximum fault-current cutoff point.
3. Motor voltage dip report shall list motors and report on voltage dip expected at motor. Particular attention shall be paid to chiller and fire pump motors.

G. Completed data sheets for setting of overcurrent protective devices.

END OF SECTION 260573

SECTION 260943 - NETWORK LIGHTING CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Digital-network lighting control system and associated components:
   1. Power panels.
   2. Fluorescent electronic dimming ballasts.
   3. LED drivers.
   4. Power interfaces.
   5. Main units (Lutron Grafik Eye QS).
   6. Lighting control modules (Lutron Energi Savr Node).
   7. Energy meter.
   8. Digital dimming ballast and switching modules (Lutron EcoSystem).
   9. Lighting management hubs.
   10. Lighting management system computers.
   11. Lighting management system software.
   12. Control stations.
   13. Low-voltage control interfaces.
   14. Wired sensors.
   15. Wireless sensors.
   16. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 12 2400 - Window Shades: Motorized roller window shades, for interface with lighting control system.

B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

C. Section 26 2726 - Wiring Devices - Lutron:
   1. Finish requirements for wall controls specified in this section.
   2. Accessory receptacles and wallplates, to match lighting controls specified in this section.

D. Section 26 5113 - Luminaires, Ballasts, and Drivers - Lutron.

E. SectionAudio-video system, for interface with lighting control system.

1.03 REFERENCE STANDARDS

A. ANSI C12.20 - American National Standard for Electricity Meters - 0.2 and 0.5 Accuracy Classes; 2010.

B. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts - Supplements; 2011.
C. ANSI/ESD S20.20 - Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices); 2007.
D. ASTM D4674 - Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments; 2002a (Reapproved 2010).
E. IEC 60669-2-1 - Switches for Household and Similar Fixed Electrical Installations - Part 2-1: Particular Requirements - Electronic Switches; 2009.
F. IEC 60929 - AC and/or DC-Supplied Electronic Control Gear for Tubular Fluorescent Lamps - Performance Requirements; 2011.
G. IEC 61000-4-2 - Electromagnetic Compatibility (EMC) - Part 4-2: Testing and Measurement Techniques - Electrostatic Discharge Immunity Test; 2008.
H. IEC 61000-4-5 - Electromagnetic Compatibility (EMC) - Part 4-5: Testing and Measurement Techniques - Surge Immunity Test; 2008.
I. IEC 61347-2-3 - Lamp Control Gear - Part 2-3: Particular Requirements for A.C. and/or D.C. Supplied Electronic Control Gear for Fluorescent Lamps; 2011.
J. IEC 61347-2-13 - Lamp Control Gear - Part 2-13: Particular Requirements for D.C. or A.C. Supplied Electronic Control Gear for LED Modules; 2006.
K. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Cor 1, 2012).
L. ISO 9001 - Quality Management Systems-Requirements; 2008.
M. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
N. NECA 130 - Standard for Installing and Maintaining Wiring Devices; National Electrical Contractors Association; 2010.
O. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; National Electrical Manufacturers Association; 2011.
P. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2010).
Q. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
R. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.
S. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

T. UL 508 - Industrial Control Equipment; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

U. UL 508A - Industrial Control Panels; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

V. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

W. UL 935 - Fluorescent-Lamp Ballasts; Current Edition, Including All Revisions.

X. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

Y. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.

Z. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of sensors and wall controls with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate the placement of wall controls with actual installed door swings.
3. Coordinate the placement of daylight sensors with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
4. Where motorized window treatments are to be controlled by the lighting control system provided under this section, coordinate the work with other trades to provide compatible products.
5. Coordinate the work to provide luminaires and lamps compatible with the lighting controls to be installed.
6. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Preinstallation Meeting: Conduct on-site meeting with lighting control system manufacturer prior to commencing work as part of manufacturer's standard startup services. Manufacturer to review with installer:

1. Low voltage wiring requirements.
2. Separation of power and low voltage/data wiring.
3. Wire labeling.
4. Lighting management hub locations and installation.
5. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL

REQUIREMENTS", sensor locations to be reviewed in accordance with layout provided by Lighting Control Manufacturer. Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated.

6. Control locations.
7. Computer jack locations.
8. Load circuit wiring.
9. Network wiring requirements.
10. Connections to other equipment.
11. Installer responsibilities.
12. Power panel locations.

C. Sequencing:

1. Do not install sensors and wall controls until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Design Documents: Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", Lighting Control Manufacturer to provide plans indicating occupancy/vacancy and/or daylight sensor locations.

C. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.

1. Occupancy/Vacancy Sensors: Include detailed basic motion detection coverage range diagrams.

D. Shop Drawings:

1. Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.
2. Provide detailed sequence of operations describing system functions.
   a. .

E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. System Performance-Verification Documentation; Lutron LSC-SPV-DOC: Include as part of the base bid additional costs for manufacturer's enhanced documentation detailing start-up performance-verification procedures and functional tests performed along with test results.

G. Project Record Documents: Record actual installed locations and settings for lighting control system components.

H. Operation and Maintenance Data: Include detailed information on lighting control system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

I. Warranty: Submit sample of manufacturer's Warranty or Enhanced Warranty as specified in Part 1 under "WARRANTY". Submit documentation of final execution completed in Owner's name and registered with manufacturer.

J. Software: two copy of software provided under this section.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications:

1. Company with not less than ten years of experience manufacturing lighting control systems of similar complexity to specified system.
2. Registered to ISO 9001, including in-house engineering for product design activities.
3. Qualified to supply specified products and to honor claims against product presented in accordance with warranty.

D. Maintenance Contractor Qualifications: Manufacturer's authorized service representative.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1. System Requirements - Lutron, Unless Otherwise Indicated:
    a. Ambient Temperature:
        1) Lighting Control System Components, Except Those Listed Below: Between 32 and 104 degrees F (0 and 40 degrees C).
        2) Lighting Management System Computer: Between 50 and 90 degrees F (10 and 35 degrees C).
        3) Fluorescent Electronic Dimming Ballasts: Between 50 and 140 degrees F (10 and 60 degrees C).
    b. Relative Humidity: Less than 90 percent, non-condensing.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Standard Warranty, With Manufacturer Start-Up; Lutron Standard 2-Year Warranty; Lutron LSC-B2:
   1. Manufacturer Lighting Control System Components, Except Lighting Management System Computer, Ballasts/Drivers and Ballast Modules:
      a. First Two Years:
         1) 100 percent replacement parts coverage, 100 percent manufacturer labor coverage to troubleshoot and diagnose a lighting issue.
         2) First-available on-site or remote response time.
         3) Remote diagnostics for applicable systems.
      b. Telephone Technical Support: Available 24 hours per day, 7 days per week, excluding manufacturer holidays.
   2. Lighting Management System Computer: One year 100 percent parts coverage, one year 100 percent manufacturer labor coverage.
   3. Ballasts/Drivers and Ballast Modules: Five years 100 percent parts coverage, no manufacturer labor coverage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer: Lutron Electronics Company, Inc.

B. Other Acceptable Manufacturers subject to approval:
   1. nLight-Sensor Switch
   2. Hubbell
   3. Cooper Lighting Controls
   4. Products by listed manufacturers are subject to compliance with specified requirements and prior approval of Engineer.

C. Substitutions.
   1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by Engineer a minimum of 10 working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.

   2. By using pre-approved substitutions, Contractor accepts responsibility and associated costs for all required modifications to related equipment and wiring. Provide complete engineered shop drawings (including power wiring) with deviations from the original design highlighted in an alternate color for review and approval by Architect prior to rough-in.

2.02 DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS

A. Sensor Layout and Tuning: Include as part of the base bid additional costs for Lighting Control Manufacturer's Sensor Layout and Tuning service; Lutron LSC-SENS-LT:
   1. Lighting Control Manufacturer to take full responsibility for wired or wireless sensor layout and performance for sensors provided by Lighting Control Manufacturer.
   2. Lighting Control Manufacturer to analyze the reflected ceiling plans, via supplied electronic AutoCAD format, and design a detailed sensor layout that provides adequate occupancy sensor coverage and ensures occupancy and daylight sensor performance per agreed upon sequence of operations. Contractor to utilize the layouts for sensor placement.
   3. During startup, Lighting Control Manufacturer to direct Contractor regarding sensor relocation, as required, should conditions require a deviation from locations specified in the drawings.
   4. Lighting Control Manufacturer to provide up to two additional post-startup on-site service visits within one calendar year from Date of Substantial Completion to fine-tune sensor calibration per the agreed upon sequence of operations.

B. Sensor Layout and Tuning: No Lighting Control Manufacturer Sensor Layout and Tuning service to be provided; Lutron LSC-NO-SENS-LT.
   1. Contractor to utilize Lighting Control Manufacturer Installation Instructions to place/install sensors.
   2. At Pre-wire and Startup, Lighting Control Manufacturer to provide a rough sensor calibration only. Sensor fine-tuning to be the responsibility of Contractor.

C. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) as suitable for the purpose indicated.

D. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the control intent indicated.

E. Shade Control Requirements:
   1. Capable of operating shades and recalling shade presets via keypad, contact closure input, infrared receiver, lighting management system software, or other lighting control system interface.
   2. Capable of operating any individual, group, or subgroup of shade electronic drive units within system without requiring separate group controllers.
   3. Capable of assigning and reassigning individual, groups, and subgroups of shades to any control within system without requiring additional wiring or hardware changes.

4. Capable of controlling shade speed for tracking within plus or minus 0.125 inch (3.17 mm) throughout entire travel.
5. Provide 10 year power failure memory for preset stops, open and close limits, shade grouping and sub grouping and system configuration.
6. Capable of synchronizing multiple shade electronic drive units of the same size to start, stop and move in unison.
7. Capable of stopping shades within accuracy of 0.125 inch (3.17 mm) at any point between open and close limits.
8. Capable of storing up to 250 programmable stop points, including open, close, and any other position.
9. Capable of controlling lights and shades from single wall control button.

F. Design lighting control equipment for 10 year operational life while operating continually at any temperature in an ambient temperature range of 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C) and 90 percent non-condensing relative humidity.

G. Electrostatic Discharge Tolerance: Design and test equipment to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2.

H. Dimming and Switching (Relay) Equipment:
1. Designed so that electrolytic capacitors operate at least 36 degrees F (20 degrees C) below the capacitor's maximum temperature rating when the device is under fully loaded conditions at maximum rated temperature.
2. Inrush Tolerance:
   a. Utilize load-handling thyristors (SCRs and triacs), field effect transistors (FETs) and isolated gate bipolar transistors (IGBTs) with maximum current rating at least two times the rated operating current of the dimmer/relay.
   b. Capable of withstanding repetitive inrush current of 50 times the operating current without impacting lifetime of the dimmer/relay.
3. Surge Tolerance:
   a. Panels: Designed and tested to withstand surges of 6,000 V, 3,000 amps according to IEEE C62.41.2 and IEC 61000-4-5 without impairment to performance.
   b. Other Power Handling Devices: Designed and tested to withstand surges of 6,000 V, 200 amps according to IEEE C62.41.2 without impairment to performance.
4. Power Failure Recovery: When power is interrupted and subsequently restored, within 3 seconds lights to automatically return to same levels (dimmed setting, full on, or full off) as prior to power interruption.
5. Dimming Requirements:

a. Line Noise Tolerance: Provide real-time cycle-by-cycle compensation for incoming line voltage variations including changes in RMS voltage (plus or minus 2 percent change in RMS voltage per cycle), frequency shifts (plus or minus 2 Hz change in frequency per second), dynamic harmonics, and line noise.
    1) Systems not providing integral cycle-by-cycle compensation to include external power conditioning equipment as part of dimming system.
b. Incorporate electronic "soft-start" default at initial turn-on that smoothly ramps lights up to the appropriate levels within 0.5 seconds.
c. Utilize air gap off to disconnect the load from line supply.
d. Control all light sources in smooth and continuous manner. Dimmers with visible steps are not acceptable.
e. Load Types:
    1) Assign a load type to each dimmer that will provide a proper dimming curve for the specific light source to be controlled.
    2) Provide capability of being field-configured to have load types assigned per circuit.
f. Minimum and Maximum Light Levels: User adjustable on a circuit-by-circuit basis.
g. Line Voltage Dimmers:
    1) Dimmers for Magnetic Low Voltage (MLV) Transformers:
        (a) Provide circuitry designed to control and provide a symmetrical AC waveform to input of magnetic low voltage transformers per UL 1472.
        (b) Dimmers using unipolar load current devices (such as FETs or SCRs) to include DC current protection in the event of a single device failure.
    2) Dimmers for Electronic Low Voltage (ELV) Transformers: Operate transformers via reverse phase control. Alternately, forward phase control dimming may be used if dimming equipment manufacturer has recommended specific ELV transformers being provided.
    3) Dimmers for Neon and Cold Cathode Transformers:
        (a) Magnetic Transformers: Listed for use with normal (low) power factor magnetic transformers.
        (b) Electronic Transformers: Must be supported by the ballast equipment manufacturer for control of specific ballasts being provided.

h. Low Voltage Dimming Modules:
   1) Coordination Between Low Voltage Dimming Module and Line Voltage Relay: Capable of being electronically linked to a single zone.
   2) Single low voltage dimming module; capable of controlling the following light sources:
      (a) 0-10V analog voltage signal.
         (1) Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.
         (2) Sink current according to IEC 60929.
         (3) Source current.
      (b) 10-0V reverse analog voltage signal.
      (c) DSI digital communication.
      (d) DALI broadcast communication per IEC 60929:
         (1) Logarithmic intensity values complying with IEC 60929.
         (2) Linear intensity values for use with LED color intensity control.
      (e) PWM per IEC 60929.

6. Switching Requirements:
   a. Rated Life of Relays: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
   b. Switch load in a manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
   c. Provide output fully rated for continuous duty for inductive, capacitive, and resistive loads.

I. Device Finishes:
   1. Wall Controls: Match finishes specified for wiring devices in Section 26 2726, unless otherwise indicated; .
   2. Standard Colors: Comply with NEMA WD1 where applicable.
   3. Color Variation in Same Product Family: Maximum delta E of 1, CIE L*a*b color units.
   4. Visible Parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.

J. Interface with building automation system. Lutron System and Network Integration Consultation; LSC-INT-VISIT.

2.03 POWER PANELS

A. Provide power panels with configurations as indicated on the drawings.

B. General Requirements:

1. Listed to UL 508 as industrial control equipment.
2. Comply with UL 508A and IEC 60669-2-1 as applicable.
3. Delivered and installed as a listed factory-assembled panel.
4. Field wiring accessible from front of panel without removing dimmer assemblies or other components.
5. Passively cooled via free-convection, unaided by fans or other means.
6. Shipped with each dimmer in mechanical bypass position by means of jumper bar inserted between input and load terminals. Jumpers to carry full rated load current and be reusable at any time. Mechanical bypass device to allow for switching operation of connected load with dimmer removed by means of circuit breaker.
7. Provided with branch circuit protection for each input circuit unless the panel is a dedicated feed-through type panel or otherwise indicated on the drawings.
8. Branch Circuit Breakers:
    a. Listed to UL 489 as molded case circuit breaker for use on lighting circuits.
    b. Provided with visual trip indicator.
    c. Thermal-magnetic construction for overload, short-circuit, and over-temperature protection. Use of breakers without thermal protection requires dimmers/relays to have integral thermal protection to prevent failures when overloaded or ambient temperature is above rating of panel.
    d. Equipped with provision for tag-out/lock-out devices to secure circuit breakers in off position when servicing loads.
    e. Replaceable without moving or replacing dimmer/relay assemblies or other panel components.
    f. Listed as switch duty (SWD) so that loads can be switched on and off by breakers.
9. Provide panels with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings; as indicated on the drawings
    a. Minimum Short Circuit Current Rating (SCCR): to match electrical panel ratings.
10. Panel Processor; Lutron Circuit Selector:
    a. Provide the following capabilities:
        1) Operate circuit directly from panel processor for system diagnostics and provide feedback of system operation.
        2) Electronically assign each circuit to any zone in lighting control system.
        3) Determine normal/emergency function of panel and set emergency lighting levels.

b. Where indicated on the drawings, panels to provide two control links. Each circuit to be capable of transferring control based on independent programming between architectural control system and theatrical controls utilizing the USITT DMX-512 1990 or ESTA DMX-512A protocol.

c. React to changes from control within 20 milliseconds.

11. Diagnostics and Service:

a. Replacing dimmer/relay does not require re-programming of system or processor.

b. Include diagnostic LEDs for dimmers/relays to verify proper operation and assist in system troubleshooting.

c. Include tiered control scheme for dealing with component failure that minimizes loss of control for occupant.

1) If lighting control system fails, lights to remain at current level. Panel processor provides local control of lights until system is repaired.

2) If panel processor fails, lights to remain at current level. Circuit breakers can be used to turn lights off or to full light output, allowing non-dim control of lights until panel processor is repaired.

3) If dimmer fails, factory-installed mechanical bypass jumpers to allow each dimmer to be mechanically bypassed. Mechanical bypass device to allow for switching operation of connected load with dimmer removed by means of circuit breaker.

2.04 MAIN UNITS (LUTRON GRAFIK EYE QS)

A. Product: Lutron GRAFIK Eye QS.

B. Provide main units with configuration and quantity of zones as indicated or as required to control the loads as indicated.

C. Connects to lighting management hub via RS485.

D. Finish: As specified for wall controls in "Device Finishes" under DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS article above; Standard white with white top door, unless otherwise indicated; Standard white with translucent top door, unless otherwise indicated; Custom colors to be selected by Architect;

E. Engrave units with button, zone, and scene descriptions indicated on the drawings

F. Integrated Wireless Capability:

1. Provide wireless communication inputs for:

a. Occupancy sensors.

b. Daylight sensors.

c. Wireless controller.

2. RF Range: 30 feet (9 m) between sensor and compatible RF receiving device(s).
3. RF Frequency: 434 MHz; operate in FCC governed frequency spectrum for periodic operation; continuous transmission spectrum is not permitted.

G. Preset Lighting Control with Zone Override:

1. Intensity for each zone indicated by means of one illuminated bar graph per zone.
2. User-programmable zone and scene names.
3. Utilize air gap off to disconnect the load from line supply.
4. Astronomical time clock and programmer interface provides access to:
   a. Scene selections.
   b. Fade zone to a level.
   c. Fine-tuning of preset levels with scene raise/lower.
   d. Lock out scenes and zones.
   e. Fine-tuning of light levels with individual zone raise/lower.
   f. Terminal block for wired infrared signal input.
   g. Enable/disable wall station.
5. Light intensity with real time energy savings by digital display.
6. Fade time indicated by digital display for current scene while fading.
7. Integral wide angle infrared receiver.
8. For temporary local overrides, individual raise/lower buttons to allow zones to be adjusted without altering scene values stored in memory.
9. Direct Low-Voltage Control of Digital Ballasts and LED drivers (120V, 220/240V, 277V and/or 347V Lighting):
   a. Electronically link a digital fluorescent lighting ballast to a zone for both dimming and turning on/off.
   b. Electronically assign daylight sensors to digital ballasts and line voltage dimmers for proportional daylight harvesting.
   c. Single integral controller with Class 1 or Class 2 isolated digital output signal conforming to IEC 60929; capable of direct control without interface.
10. Creates daylighting rows independent of control zones.
11. Capable of re-zoning without re-wiring using programming display on unit.
12. Outputs can be virtually mapped to other device's outputs.
13. Zone raise/lower buttons capable of controlling local lighting loads connected to the main unit or remote lighting zones in the system.

H. Preset Shade Control with Zone Override:

1. Preset expandable shade control: Provide up to three columns of shade control.

2. For temporary local overrides, individual raise/lower buttons to allow zones to be adjusted without altering scene values stored in memory.

I. Provides one direct-wired occupancy sensor connection without interface or power pack.

2.05 LIGHTING CONTROL MODULES (LUTRON ENERGI SAVR NODE)

A. Provide lighting control modules as indicated or as required to control the loads as indicated.

B. General Requirements:

1. Listed to UL 508 as industrial control equipment.
2. Delivered and installed as a listed factory-assembled panel.
3. Passively cooled via free-convection, unaided by fans or other means.
4. Mounting: Surface.
5. Connection without interface to wired:
    a. Occupancy sensors.
    b. Daylight sensors.
    c. IR receivers for personal control.
6. Connects to lighting management hub via RS485.
7. LED status indicators confirm communication with occupancy sensors, daylight sensors, and IR receivers.
8. Contact Closure Input:
    a. Directly accept contact closure input from a dry contact closure or sold-state output without interface to:
        1) Activate scenes.
            (a) Scene activation from momentary or maintained closure.
        2) Enable or disable after hours.
            (a) Automatic sweep to user-specified level after user-specified time has elapsed.
            (b) System will provide occupants a visual warning prior to sweeping lights to user-specified level.
            (c) Occupant can reset timeout by interacting with the lighting system.
        3) Activate or deactivate demand response (load shed).
            (a) Load shed event will reduce lighting load by user-specified amount.
9. Emergency Contact Closure Input:
    a. Turn all zones to full output during emergency state via direct contact closure input from UL 924 listed emergency lighting interface, security system or fire alarm system.
    b. Allow configurable zone response during emergency state.
    c. Disable control operation until emergency signal is cleared.

10. Supplies power for control link for keypads and control interfaces.
11. Distributes sensor data among multiple lighting control modules.
12. Capable of being controlled via wireless sensors and controls.

C. Switching Lighting Control Modules:
   1. Product(s):
      a. Lutron SoftSwitch Energi Savr Node; Model QSN-4S16-S: 16 A continuous-use per channel.
      b. Lutron SoftSwitch Energi Savr Node; Model QSN-4S20-S: 20 A (16 A ballast) continuous-use per channel.
   2. Switching:
      a. Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
      b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
      c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.
      d. Module to integrate up to four individually controlled zones.
      e. Utilize air gap off, activated when user selects "off" at any control to disconnect the load from line supply.

D. 0-10V Lighting Control Modules:
   1. Product(s):
      a. Lutron 0-10V Energi Savr Node; Model QSN-4T16-S: 16 A continuous-use per channel.
      b. Lutron 0-10V Energi Savr Node; Model QSN-4T20-S: 20 A (16 A ballast) continuous-use per channel.
   2. Coordination Between Low Voltage Dimming Module and Line Voltage Relay: Capable of being electronically linked to single zone.
   3. Single low voltage dimming module; capable of controlling following light sources:
      a. 0-10V analog voltage signal.
         1) Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.
         2) Sink current per IEC 60929.
      b. 10V-0V analog voltage signal.
         1) Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.
         2) Sink current per IEC 60929.
   4. Switching:
      a. Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.

b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.
d. Module to integrate up to four individually controlled zones.
e. Utilize air gap off, activated when user selects "off" at any control to disconnect the load from line supply.

E. Digital Fixture Lighting Control Modules:
1. Product(s):
a. Lutron EcoSystem Energi Savr Node; Model QSN-1ECO-S: One EcoSystem Digital Link.
b. Lutron EcoSystem Energi Savr Node; Model QSN-2ECO-S: Two EcoSystem Digital Links.
2. Provides two-way feedback with digital fixtures for energy monitoring, light level status, lamp failure reporting, and ballast/driver failure reporting.
3. Provide testing capability using manual override buttons.
4. Each low-voltage digital communication link to support up to 64 ballasts or LED drivers capable of NFPA 70 Class 1 or Class 2 installation.

F. Total Light Management Control Module (Digital Lighting and Shades Control):
1. Product: Lutron EcoSystem with Shades Energi Savr Node; Model QSN-2ECO-PS120 - Two EcoSystem Digital Links.
2. Ten fused 30W (60W peak) 24V DC outputs provide power to compatible shades, drapery drive units, keypads, and accessories.
3. Provide power for 10 to 30 shades dependent on shade dimensions.
4. Provide smart diagnostics for system verification.
5. Provide testing capability using manual override buttons.
6. Each low-voltage digital communication link to support up to 64 ballasts capable of NFPA 70 Class 1 or Class 2 installation.

2.06 ENERGY METER

A. Product: Lutron Quantum CPN5898 Series Class 500 Energy Meter.

B. General Requirements:
1. Provides accurate, real-time energy metering and verification capability through front-end PC-based software.
2. Factory-calibrated; not requiring preventative/scheduled maintenance or cleaning/decontamination procedures.
3. Accepts up to three sets of current sensors to monitor up to three loads of the same voltage with one meter.
4. Contains direct-read 8-digit LCD display of cumulative kWh.

5. Current Sensors: Split-core; capable of being placed up to 500 feet (152 m) from the meter without power interruption.
6. Connects to server via Ethernet.
7. UL listed.
8. Accuracy: Plus/minus 0.5 percent, certified to ANSI C12.20.
9. NEMA 12 housing.
10. Provide voltage and current ratings suitable for the installed location.

2.07 DIGITAL DIMMING BALLAST AND SWITCHING MODULES (LUTRON ECOSYSTEM)

A. Provide digital dimming ballast and switching modules as indicated or as required to control the loads as indicated.

B. General Requirements:

1. Provide continuous 3-wire signal dimming to compatible 3-wire electronic dimming ballasts.
2. Utilize air gap off to disconnect the load from line supply.
3. Connect without interface to:
   a. Occupancy sensor.
   b. Daylight sensor.
   c. Personal control input (wall station or infrared receiver).
4. Generate digital communication commands to distribute ballast and sensor data on the digital bus.
5. If power is interrupted and subsequently restored, lights automatically return to the setting prior to power interruption.
6. Each ballast module responds independently to:
   a. Up to 32 occupancy sensors.
   b. Up to 64 personal control inputs.
   c. Two daylight sensors.
7. Unique internal reference number visible displayed on module cover.
8. Averages two independent daylight harvesting inputs internally.
9. Responds to digital load shed command.
   a. Sets high end trim.
   b. Automatically scales light output proportional to load shed command. (Example: If light output is at 30 percent and a load shed command of 10 percent is received, the ballast to automatically set the maximum light output at 90 percent and lower current light output by 3 percent to 27 percent).
10. Provide integral fault protection to prevent ballast module failure in the event of a mis-wire.

C. Product(s):

1. 3-Wire Ballast Module, 2 Amp; Lutron EcoSystem Model C5-BMF-2A:
    a. Integrates up to 2 amps of 3-wire electronic dimming ballasts into EcoSystem digital control system as a single zone.
2. 3-Wire Ballast Module, 16 Amp; Lutron EcoSystem Model C5-BMJ-16A:
    a. Integrates up to 16 amps of 3-wire electronic dimming ballasts into EcoSystem digital control system as a single zone.
    b. Integrates up to 16 amps of switched high intensity discharge (HID) lighting load into EcoSystem digital control system as a single zone.
3. Switching Power Module, 16 Amp; Lutron EcoSystem Model C5-XPJ-16A:
    a. Integrates up to 16 amps of high in-rush lighting load (magnetic fluorescent ballast, electronic fluorescent ballast, HID, incandescent, magnetic low-voltage, electronic low-voltage, neon/cold cathode and motor loads) into EcoSystem digital control system as a single zone.

2.08 LIGHTING MANAGEMENT HUBS

A. Product: Lutron Quantum Light Management Hub.

B. Provided in a pre-assembled NEMA listed enclosure with terminal blocks listed for field wiring.

C. Connects to controls and power panels via RS485.

D. Enables light management software to control and monitor compatible dimming ballasts and ballast modules, power panels, power modules, and window treatments.
    1. Utilizes Ethernet connectivity to light management computer utilizing one of the following methods:
        a. Dedicated network.
        b. Dedicated VLAN.
        c. Shared network with Building Management System (BMS).
        d. Corporate network where managed switches are configured to allow multicasting and use of IGMP.

E. Integrates control station devices, power panels, shades, preset lighting controls, and external inputs into a single customizable lighting control system with:
    1. Multiple Failsafe Mechanisms:
        a. Power failure detection via emergency lighting interface.
        b. Protection: Lights go to full on if ballast wires are shorted.
        c. Distributed architecture provides fault containment. Single hub failure or loss of power does not compromise lights and shades connected to other lighting management hubs.
    2. Manual overrides.
    3. Automatic control.

4. Central computer control and monitoring.
5. Integration with BMS via BACnet.

F. Furnished with astronomical time clock.

G. Furnished with solar clock to track the position of the sun to control the shades to limit penetration of direct sunlight.

H. Maintains a backup of the programming in a non-volatile memory capable of lasting more than ten years without power.

I. BACnet Integration License:

1. Provide ability to communicate by means of native BACnet IP communication (does not require interface) to lighting control system from a user-supplied 10BASE-T or 100BASE-T Ethernet network.
2. Requires only one network connection per system.
3. Lighting control system to be BACnet Test Laboratory (BTL) listed.
4. Basic BACnet integration license:
    a. The BACnet integrator can command:
        1) Area light output.
        2) Area enable or disable after hours mode.
        3) Area load shed level.
        4) Area load shed enable/disable.
        5) Area shade group presets and levels.
        6) Enable/Disable:
            (a) Automated solar adaptive shade control.
            (b) Cloudy day/shadow override mode for automated shade control.
            (c) Brightness override mode for automated shade control.
            (d) Area occupancy sensors.
            (e) Area daylighting.
        7) Daylighting level.
        8) Area occupied and unoccupied level
        9) Occupancy sensor timeouts.
    b. The BACnet integrator can monitor:
        1) Area on/off status.
        2) Area occupancy status.
        3) Area fault.
            (a) Lamp failures.
            (b) Control devices not responding.
        4) Area load shed status.
        5) Area instantaneous energy usage and maximum potential power usage.

6) Energy savings broken out by strategy (occupancy, timeclock, daylighting, personal control, tuning, load shed) down to the individual area.
7) Area shade group presets and levels.
8) Cloudy day and shadow sensor status.
9) Light levels from window mounted sensors.
10) Enable/Disable:
    (a) Status of automated solar adaptive shade control.
    (b) Status of cloudy day/shadow override for automated shade control.
    (c) Status of brightness override for automated shade control.
    (d) Area occupancy sensors.
    (e) Daylighting.
11) Daylighting level.
12) Light levels from photo sensors and window mount shadow sensors.
13) Area occupied and unoccupied level.
14) Occupancy sensor timeouts.

c. Shade assignment and grouping to be discoverable with third party building management software.

2.09 LIGHTING MANAGEMENT SYSTEM COMPUTERS (provided by owner)

2.10 LIGHTING MANAGEMENT SYSTEM SOFTWARE

A. Provide system software license and hardware that is designed, tested, manufactured, and warranted by a single manufacturer.

B. Configuration Setup Software:
1. Product: Lutron Q-Design.
2. Suitable to make system programming and configuration changes.
3. Windows-based, capable of running on either central server or a remote client over TCP/IP connection.
4. Allows manufacturer (either remotely or with on-site service call); end-user (with training to:
    a. Capture system design:
        1) Geographical layout.
        2) Load schedule zoning.
        3) Shade grouping.
        4) Equipment schedule.
        5) Equipment assignment to lighting management hubs.

6) Daylighting design.

b. Define the configuration for the following in each area:

1) Lighting scenes.
2) Shade group presets.
3) Control station devices.
4) Interface and integration equipment.
5) Occupancy/after hours.
6) Partitioning.
7) Daylighting.
8) Emergency lighting.
9) Night lights.

c. Startup:

1) Addressing.
2) Daylighting.
3) Provide customized conditional programming.

C. Control and Monitor Software:

1. Products:

a. Lutron Quantum Vue (web-based application).
b. Lutron Q-Admin (desktop application).

2. Accessibility and Platform Support:

a. Lutron Quantum Vue Web-Based Application:

1) Web-based; runs on most HTML5 compatible browsers (including Internet Explorer, Chrome, and Safari).
2) Supports multiple platforms and devices; runs from a tablet, desktop, laptop, or smartphone; optimized for displays of 1024 by 768 pixels or higher.
3) User interface supports multi-touch gestures such as pinch to zoom, drag to pan, etc.
4) Utilizes HTTPS (industry-standard certificate-based encryption and authentication for security).

b. Lutron Q-Admin Desktop Application:

1) Client installation for Windows-based operating systems only.

3. System Navigation and Status Reporting:

a. Lutron Quantum Vue Web-Based Application: Performed using graphical floor plan view or a generic system layout.

1) Graphical Floor Plan View: Utilizes customized CAD based drawing of the building. Pan and zoom feature allows for easy navigation; dynamically adjusts the details presented based on zoom level.
2) Area, scene, and zone names can be changed in real time.

b. Lutron Q-Admin Desktop Application: Performed using basic system tree view.

4. Control of Lights:
   a. Area lights can be monitored for on/off status.
   b. All lights in an area can be turned on/off or sent to a specific level.
   c. For areas that have been zoned, these areas may be sent to a predefined lighting scene, and individual zones may be controlled.
   d. Area lighting scenes can be renamed and modified in real-time, changing the levels that zones go to when a scene is activated.
   e. High and low end of area lighting can be tuned/trimmed.
   f. Control and monitor area partition status.
5. Control of Shades:
   a. Area shades can be monitored for current preset or position.
   b. Area shades can be opened/closed, sent to a preset, or sent to a specific position.
6. Occupancy:
   a. Area occupancy can be monitored.
   b. Area occupancy can be disabled to override occupancy control or in case of occupancy sensor problems.
   c. Area occupancy settings including level that lights turn on to when area is occupied, and level that lights turn off to when area is unoccupied can be changed in real-time.
   d. Monitor energy savings due to occupancy down to an individual area.
7. Daylighting:
   a. Daylighting can be enabled/disabled. Can be used to override the control currently taking place in the space.
   b. Daylight calibration can be adjusted for each daylit area.
   c. Daylight status can be monitored.
   d. Monitor energy savings due to daylight harvesting down to an individual area.
8. Load Shedding; Lutron IntelliDemand: Allows the building manager to monitor whole building lighting power usage and apply a customized load shed reduction to selected areas, thereby reducing a building's power usage; load shedding triggered via Quantum software, BACnet, or OpenADR.

9. Scheduling: Schedule time of day and astronomic time clock events to automate functions.
    a. Adjust or disable a single occurrence of a repeating scheduled event.
    b. Easily monitor and adjust scheduled events using a weekly calendar view.
10. Reporting: Provide reporting capability that allows the building manager to gather real-time and historical information about the system as follows:
    a. Energy Reports: Show a comparison of cumulative energy used over a period of time for one or more areas or meter groups.
    b. Power Reports: Show power usage trend over a period of time for one or more areas or meter groups.
    c. Energy Density Report: Show energy usage in W/sq ft.
    d. Energy Savings By Strategy Report: Show energy savings for any area broken down by strategy (tuning, occupancy, daylighting, scheduled events, personal control, and load shedding).
    e. Activity Report: Show what activity has taken place over a period of time for one or more areas. Activity includes occupant activities (e.g. wall controls being pressed), building manager operation (e.g. controlling/changing areas using the control and monitor tool), and device failures (e.g. keypads or ballasts that are not responding).
        1) Include shade related activities (e.g. automatic movements from Hyperion automated shade algorithm, manual overrides from personal controls, automatic overrides from sensors).
    f. Lamp Failure Report: Shows which areas are currently reporting lamp failures.
    g. Shade Level Report: Shows the shade level for any shade group in the system over any historical 24 hour period.
    h. Shade Position Report: Shows the percentage of time shade groups in the system are at each position.
    i. Sensor Level Report: Shows the light level in footcandles of any photosensor in the system.
    j. Alert Activity Report: Capable of generating historical reports of all alert activity within the system.
    k. Hyperion Automated Shade Control Activity Report: A chart that combines multiple data points regarding the position and performance of Hyperion automated shades.
11. Diagnostics: Allows the building manager to check on the status of all equipment in the lighting control system. Devices to be listed with a reporting status of OK, missing, or unknown.

12. Alerts and Alarms: Monitors the system for designated events/triggers and automatically generates alerts according to configured response criteria.
    a. Capable of monitoring for the following events/triggers:
        1) A failed piece of equipment (e.g. ballast, control, sensor, etc.); alert cleared when equipment is replaced.
        2) A lamp outage (for compatible EcoSystem digital electronic dimming ballasts only); alert cleared when lamp is replaced.
        3) Low battery conditions in battery-operated sensors and controls; alert cleared when battery is replaced.
        4) Luminaires with lamp operating hours in excess of designated time.
        5) A load shed event; alert generated for beginning and end of trigger.
        6) Energy usage higher than designated threshold target.
        7) Potential light level condition discrepancies (daylight sensors not agreeing with expected lighting status).
    b. View alerts on a customized graphical floor plan.
    c. Capable of generating alerts through visible changes in software or through email messages.
    d. Capable of customizing the frequency of alerts and providing notifications immediately or through daily, weekly, or monthly summaries.
    e. Capable of sending different alerts to different system users.
    f. Capable of generating historical reports of all alert activity within the system.
13. Administration:
    a. Users: Allows new user accounts to be created and existing user accounts to be edited.
        1) Supports Active Directory (LDAP) tying user accounts to network accounts.
    b. Area and feature access can be restricted based on login credentials with three levels of access rights (Admin, Programmer, Controller) and customized access levels available.
    c. Publish Graphical Floor Plan: Allows admin user to publish new graphical floor plan files, allowing users to monitor the status of lights, occupancy of areas, and daylighting status.
    d. Back-Up Project Database: Allows admin user to back up the project database that holds all the configuration information for the system, including keypad programming, areas scenes, daylighting, occupancy programming, emergency levels, night lights, and time clock.

e. Publish Project Database: Allows admin user to send a new project database to the server and download the new configuration to the system. The project database holds all the configuration information for the system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights, and time clock.

14. Favorite Buttons: Provide global scene control or modes of operation across the entire system.
15. Provides control/monitoring of partition status to automatically reconfigure how the space operates based on the partition's open/closed status.

D. Energy Savings Display Software:
1. Product: Lutron GreenGlance.
2. Provide software from a single manufacturer that can collect and display real-time and historical energy savings data from all of the components in the lighting control system or from the meters in the system.
3. Energy savings data to be accessible for display on computer terminal or user-supplied display monitor via energy savings display software.
4. Software to be capable of displaying:
a. Current savings in percent and kW.
b. Historic energy savings in kWh saved, money saved, coal not burned, and carbon dioxide not emitted.
c. Historical views in time periods of three hours, one day, one week, one month, and one year.
d. Configurable energy usage baseline and user-defined working hours for energy saving calculations.
e. Comparisons of historical periods (days, weeks, months, years).
f. Local weather conditions.

E. Web Services Integration License:
1. Provide ability to communicate by means of XML web services
2. Web services integrator can monitor:
a. Area instantaneous power usage.
b. Area instantaneous power savings.
c. Area energy savings.
d. Area energy usage.
e. Area maximum power usage.
3. Initiate load shed event using OpenADR protocol in an auto-Demand-Response event without additional interfaces or gateways.

4. Supports both push and pull for integration with third party systems and energy dashboards.

F. Quantum Mobile Control and Programming Software License:
1. Allows mobile control and programming of Quantum system via an Apple iPad.
2. Provides users the ability to:
a. Control and monitor area lighting scenes, zones, and shade presets.
b. Easily identify zones and shade groups.
c. Edit area lighting scenes, shade presets, scene fade rates, and scene delay rates.
d. Restrict user access by area.
e. Restrict users from ability to make changes.
f. Historical logging of who made changes available in Q-Admin control and monitor software.
3. Connects to Quantum system via Wi-Fi.
4. Can connect directly to processor or through computer (server) in the system.

G. Personal Web-Based Control Software:
1. Product: Lutron Personna PC.
2. Lighting Control: Allows the user to use a web browser on their personal PC, laptop, or some mobile devices (supporting 1024 by 768 resolution) to control one or more lights in their area.
a. The user may select between full on, full off, or a favorite light level.
b. The user may raise/lower the currently selected lighting level in the area.
3. Shade Control: Allows the user to use a web browser on their personal PC, laptop, or some mobile devices (supporting 1024 by 768 resolution) to control one or more shades in their area.
a. The user may select open, closed, or a favorite shade position.
b. The user may raise/lower a selected shade group in the area.
4. Supports up to 10,000 users.
5. Each user to have a login name and password sent from administrator via email when user account created.
6. Supported Browsers: Microsoft Internet Explorer (versions 7 and higher), Mozilla Firefox (versions 3 and higher), Apple Safari (versions 4 and higher), Google Chrome (versions 8 and higher).

H. Automated Shade Control Software:
1. Product: Lutron Hyperion.
2. Objectives:

a. Uses open loop solar adaptive algorithm to minimize the penetration depth of direct sunlight.
b. Optimizes energy savings from daylight.
c. Provides manual override capability for occupants via wall-mounted keypad or simple remote control.
d. Provides automatic override capability utilizing a local sensor in dark conditions or when excessive brightness occurs.
e. Maximizes occupants' connectivity with outdoors by optimizing view.
f. Provides diffuse daylight and minimizes direct sunlight in the space to reduce solar heat gain and maximize occupant comfort in the space.
g. Reduces glare.
h. Shades along same facade to start, stop and track in unison to maintain a consistent exterior aesthetic.
i. Provides optional presets to allow shades to align with architectural elements of the facade.
j. Provides a preset, also referred to as visor position, to limit maximum amount of light entering a space.
k. Provides configurable dark and bright override positions.

3. Hardware: Independent operation of solar tracking program through non-Windows based operating system provided in one or more lighting management hubs.
4. Control Software:
   a. Incorporates a solar tracking software that:
      1) Calculates the sun's position in the sky relative to the building and then calculates when shade movement is necessary by facade.
      2) Calculates the position of the shade to limit direct sunlight penetration to a predetermined limit.
   b. Controlled using the following inputs for startup:
      1) Building location.
      2) Facade orientation.
      3) Window dimensions.
      4) Solar depth of penetration.
      5) Number of shade movements per day.
      6) Visor position of shades.
      7) Optional presets that align shades with architectural features of the facade.
      8) Light level thresholds for dark and bright override.
      9) Shade position for dark and bright override.

10) Window position on wall.

c. Requires minimal long term maintenance and service. Does not require user to make daily changes to programming or overall system functionality, unless desired by owner.

5. PC Graphic User Interface: Provides access to all adjustable parameters of solar depth of penetration and number of shade movements per day.

6. Override:

a. Manual:

1) Temporary override of the control program capability through optional manual keypads, remote controls, or end-user control software.

2) Keypads, remote controls, or end-user control software to be capable of providing manual control of shades in a particular area.

3) Time of manual override to be programmable.

b. Automatic overrides achievable via rooftop cloudy day sensors or radio window sensors:

1) Rooftop Cloudy Day Sensors:

(a) Product: Lutron Cloudy Day Sensor; Model QS-CES-R.

(b) Provides automatic override of system on dark cloudy days.

(c) During dark conditions, shades to go to predetermined visor position to maximize view and available daylight.

2) Radio Window Sensors:

(a) Product(s):

(1) Lutron Radio Window Sensor; Model LRF2-SSM-XX (mullion mount sensor pair).

(2) Lutron Radio Window Sensor; Model LRF2-SSW-WH (window mount).

(b) Monitors exterior light conditions and provides automatic override of system on dark cloudy days or in the presence of shadows from neighboring buildings and rooftop mechanical equipment.

(c) During dark conditions, shades to go to predetermined dark override position to maximize view and available daylight.

(d) Monitors exterior light conditions and provides automatic override of system during excessive brightness.

(e) During excessive bright conditions, shades to go to predetermined bright override position to maximize occupant comfort.

(f) Capable of having one or multiple sensors per facade for more localized detection of exterior light conditions.

(g) Capable of having one sensor control one shade group or multiple shade groups.

(h) Software enables the ability to adjust thresholds, timeouts, and shade movement frequency globally or per area to meet the unique preferences of different individuals.

(i) Sensor to not require external power packs, power wiring, or communication wiring.

(j) Sensor to be easily mountable to mullion (mullion mount sensor pair) or window (window mount) and can be easily removed and repositioned without marring or damaging window surface.

(k) Provides typical battery lifetime of 10 years when installed per manufacturer instructions.

(l) Communicates directly to compatible Lutron QS sensor module via Lutron Clear Connect Technology to ensure reliable RF communications.

(m) RF Frequency: 434 MHz.

(n) RF Range: 30 feet (9 m) between sensor and compatible RF receiving device(s).

(o) Intuitive test mode to provide instant system verification of associated shades and programmed visor position.

2.11 CONTROL STATIONS

A. Provide control stations with configuration as indicated or as required to control the loads as indicated.

B. Wired Control Stations:

1. General Requirements:
   a. Class 2 (low voltage).
   b. UL listed.
   c. Control stations can be replaced without reprogramming.
   d. Finish: <<As specified for wall controls in "Device Finishes" under DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS article above
      .
2. Product(s):
   a. Multi-Scene Wired Control:
      1) Product(s):
         (a) Lutron seeTouch QS.
         (b) Lutron Signature Series.

(c) Lutron Architrave.

2) Allows control of any devices part of the lighting control system.

3) Utilize RS485 wiring for low-voltage communication.

4) Functionality:

(a) Upon button press, LEDs to immediately illuminate.

(b) LEDs to reflect the true system status. LEDs to remain illuminated if the button press was properly processed or LEDs to turn off if the button press was not processed.

(c) Allows for easy reprogramming without replacing unit.

(d) Replacement of units does not require reprogramming.

5) Provide faceplates with concealed mounting hardware.

6) Engrave wall stations with button, zone, and scene descriptions as indicated on the drawings

7) Silk-screened borders, logos, and graduations to use graphic process that chemically bonds graphics to faceplate, resistant to removal by scratching and cleaning.

8) Software Configuration:

(a) Customizable control station device button functionality:

(1) Buttons can be programmed to perform single defined action.

(2) Buttons can be programmed to perform defined action on press and defined action on release.

(3) Buttons can be programmed using conditional logic off of a state variable such as time of day or partition status.

9) Control station device LEDs to support logic that defines when it is illuminated:

(a) Scene logic (logic is true when all zones are at defined levels).

(b) Room logic (logic is true when at least one zone is on).

(c) Pathway (logic is true when at least one zone is on).

(d) Last scene (logic is true when spaces are in defined scenes).

10) Contact Closure Interface: Accepts both momentary and maintained contact closures.

11) Provide integral infrared receiver for personal control where indicated

b. Single-Scene or Zoned Wired Control:

1) Product: Lutron Pico Wired Control.

2) Turn an individual fixture or group of fixtures on and off.

3) Raise and lower light levels.

4) Recall favorite light levels.

c. Four-Button Preset Wallstation:
   1) Product: Lutron EcoSystem CC-4BRL Four-Button Control.
   2) Recall four scenes plus all on or all off for one group of fixtures.
   3) Master raise/lower control for entire group of fixtures.
   4) Integral IR receiver for personal control.
   5) Immediate local LED response upon button activation to indicate that a system command has been requested.

d. Wired Keyswitch:
   1) Product: Lutron QS Keyswitch.
   2) Configuration:
      (a) Lutron Model QSWS2-KSI-3MOC.
      (b) Lutron Model QSWS2-KSI-3MAC.
      (c) Lutron Model QSWS2-KSI-2MAC.
      (d) Lutron Model QSWS2-KSI-2MAA.
   3) Allows control of any devices part of the lighting control system.
   4) Utilize RS485 wiring for low-voltage communication.
   5) Functionality:
      (a) Allows for easy reprogramming without replacing unit.
      (b) Requires key insertion to activate actions.
   6) Provide faceplates with concealed mounting hardware.
   7) Engrave wall stations with button, zone, and scene descriptions as indicated on the drawings
   8) Silk-screened borders, logos, and graduations to use graphic process that chemically bonds graphics to faceplate, resistant to removal by scratching and cleaning.
   9) Software Configuration:
      (a) Customizable control station device button functionality:
         (1) Key positions can be programmed to perform single defined action.
         (2) Key positions can be programmed using conditional logic off of a state variable such as time of day or partition status.

e. Slider Control:
   1) Product: Lutron QS Slider Control.
   2) Allows control of any lighting zone in the system via intuitive analog slider control.
   3) Utilize RS485 wiring for low-voltage communication.

4) Available in 1 to 16 zone configurations.
5) Available with or without a take switch to activate the slider scene.
6) Optional keypad ganging.
7) Slider zones can be chained in partitioned spaces.
8) Provide faceplates with concealed mounting hardware.
9) Provide customizable engraving of faceplate indicated on the drawings
10) Functionality:
(a) Full range dimming of individual zones or groups of zones.
(b) Zone levels indicated by slider position.
(c) Integrates with multi-scene wired control.

C. Wireless (Radio Frequency) Controls:
a. Single Pedestal; Lutron Pico Pedestal Model L-PED1.
b. Double Pedestal; Lutron Pico Pedestal Model L-PED2.
c. Triple Pedestal; Lutron Pico Pedestal Model L-PED3.
d. Quadruple Pedestal; Lutron Pico Pedestal Model L-PED4.
e. Screw Mounting Kit; Lutron Model PICO-SM-KIT.
f. Wallplate Adapter; Lutron Model PICO-FP-ADAPT.
2. Quantity: As indicated on the drawings;
3. Communicates via radio frequency to compatible dimmers, switches, and plug-in modules.
4. Does not require external power packs, power or communication wiring.
5. Allows for easy reprogramming without replacing unit.
6. Button Programming:
a. Single action.
b. Toggle action.
c. Defined action on press and defined action on release.
7. Includes LED to indicate button press or programming mode status.
8. Models available with integral night light.
9. Mounting:
a. Capable of being mounted with a table stand or directly to a wall under a faceplate.
b. Faceplates: Provide concealed mounting hardware.
10. Power: Battery-operated with minimum ten-year battery life.
11. Finish: As specified for wall controls in "Device Finishes" under DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS article above

D. Infrared Handheld Controls:
1. Product(s):

a. Four-Scene Wireless Infrared Transmitter; Lutron Model GRX-IT-WH: Operates up to 50 feet (15 m) line-of-sight to receiver.
b. Single-Scene Wireless Infrared Transmitter; Lutron Model C-FLRC-WH: Operates up to 12 feet (3.7 m) line-of-sight to receiver.

2. Quantity: As indicated on the drawings.
3. Designed for use in conjunction with compatible infrared receiver and lighting control; compatibility dependent on that receiver, not transmitter.
4. Learnable by other variable frequency remote controls.

2.12 LOW-VOLTAGE CONTROL INTERFACES

A. Provide low-voltage control interfaces as indicated or as required to control the loads as indicated.

B. Connects to lighting management hub via RS485.

C. UL listed.

D. Contact Closure Interface:
1. Product: Lutron Model QSE-IO.
2. The contact closure input device to accept both momentary and maintained contact closures.
3. The contact closure output device can be configured for maintained or pulsed outputs.
4. Contact closure can be programmed using conditional logic off of a state variable such as time of day or partition status.

E. Wallbox Input Closure Interface:
1. Product: Lutron Model QSE-CI-WCI.
2. Mounts in wallbox behind contact closure keypad to provide interface for up to eight contact closure inputs.
3. The contact closure input device to accept both momentary and maintained contact closures.

F. RS232 and Ethernet Interface:
1. Product: Lutron Model QSE-CI-NWK-E.
2. Provide ability to communicate via Ethernet or RS232 to audiovisual equipment, touchscreens, etc.
3. Allow creation of custom output strings.
4. Provide control of:
a. Light scene selections.
b. Fine-tuning of light scene levels with raise/lower.
c. Shade group presets.
d. Fine-tuning of shade preset levels with raise/lower.
e. Simulate system wall station button presses and releases.

5. Provide status monitoring of:
    a. Light scene status.
    b. Shade group status.
    c. Wall station button presses and releases.
    d. Wall station LEDs.
6. Provide ability to send custom output strings.

G. DMX Interface:
1. Product: Lutron Model QSM-CI-DMX.
2. Provide ability to:
    a. Map a single zone intensity to a single DMX512 lighting channel.
    b. Map a single zone intensity to three DMX512 channels for RGB/CMY color control.
    c. Map a single zone intensity to a single DMX512 integration channel.
    d. Smoothly transition from one color to another in a cross fade.
    e. Automatically sequence through a variety of colors.
    f. Download, program, and customize a color wheel for each unit.

H. Sensor Modules:
1. Products:
    a. Sensor module with both wired and wireless inputs; Lutron Model QSM2-4W-C.
    b. Sensor module with wired inputs only; Lutron Model QSMX-4W-C.
    c. Sensor module with wireless inputs only; Lutron Model QSM2-XW-C.
2. Wired Modules:
    a. Provide wired inputs for:
        1) Occupancy sensors.
        2) Daylight sensors.
        3) IR receivers for personal control.
        4) Digital ballast wall stations.
3. Wireless Modules:
    a. Provide wireless communication inputs for:
        1) Occupancy sensors.
        2) Daylight sensors.
        3) Wireless controller.
    b. RF Range: 30 feet (9 m) between sensor and compatible RF receiving devices.
    c. RF Frequency: 434 MHz; operates in FCC governed frequency spectrum for periodic operation; continuous transmission spectrum is not permitted.
4. Communicate sensor information to wired low-voltage digital link for use by compatible devices.

2.13 WIRED SENSORS

A. Wired Occupancy Sensors:

1. General Requirements:
    a. Connects directly to compatible ballasts and modules without the need of a power pack or other interface.
    b. Turns off or reduces lighting automatically after reasonable time delay when a room or area is vacated by the last person to occupy the space.
    c. Accommodates all conditions of space utilization and all irregular work hours and habits.
    d. Comply with UL 94.
    e. Self-Adaptive: Continually adjusts sensitivity and timing to ensure optimal lighting control for any use of the space.
    f. Furnished with field-adjustable controls for time delay and sensitivity to override any adaptive features.
    g. Provide capability to:
        1) Add additional timeout system-wide without need to make local adjustment on sensor.
        2) Group multiple sensors.
    h. Power Failure Memory: Settings and learned parameters to be saved in non-volatile memory and not lost should power be interrupted and subsequently restored.
    i. Furnished with all necessary mounting hardware and instructions.
    j. Class 2 devices.
    k. Ceiling-Mounted Sensors: Indicate viewing directions on mounting bracket.
    l. Wall-Mounted Sensors: Provide swivel-mount base.
    m. Color: White.
2. Wired Passive Infrared Sensors:
    a. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
    b. Ceiling-Mounted Sensors: Provide customizable mask to block off unwanted viewing areas.
    c. Product(s):
        1) Lutron Model LOS-CIR-450-WH; or Lutron Model ULOS-CIR-450-WH (BAA-Buy American Act Compliant): Coverage of 450 square feet (42 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view.

2) Ceiling-Mounted Passive Infrared Sensor, 1500 square feet (140 sq m); Lutron Model LOS-CIR-1500-WH; or Lutron Model ULOS-CIR-1500-WH (BAA-Buy American Act Compliant: Coverage of 1500 square feet (140 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view.

3) Wall-Mounted Passive Infrared Sensor; Lutron Model LOS-WIR-WH; or Lutron Model ULOS-WIR-WH (BAA-Buy American Act Compliant): Coverage of 1600 square feet (149 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 110 degree field of view.

3. Wired Ultrasonic Sensors:
   a. Utilize an operating frequency of 32 kHz or 40 kHz, crystal-controlled to operate within plus/minus 0.005 percent tolerance.
   b. Product(s):
      1) Ceiling-Mounted Ultrasonic Sensor, 500 square feet (46 sq m); Lutron Model LOS-CUS-500-WH; or Lutron Model ULOS-CUS-500-WH (BAA-Buy American Act Compliant) Coverage of 500 square feet (46 sq m) with ceiling height of 8 to 12 feet (2.6 to 3.7 m); 180 degree field of view.
      2) Ceiling-Mounted Ultrasonic Sensor, 1000 square feet (93 sq m); Lutron Model LOS-CUS-1000-WH; or Lutron Model ULOS-CUS-1000-WH (BAA-Buy American Act Compliant): Coverage of 1,000 square feet (93 sq m) with ceiling height of 8 to 12 feet (2.6 to 3.7 m); 180 degree field of view.
      3) Ceiling-Mounted Ultrasonic Sensor, 2000 square feet (186 sq m); Lutron Model LOS-CUS-2000-WH; or Lutron Model ULOS-CUS-2000-WH (BAA-Buy American Act Compliant); Coverage of 2000 square feet (186 sq m) with ceiling height of 8 to 12 feet (2.6 to 3.7 m); 360 degree field of view.
4. Wired Dual Technology Sensors:
   a. Passive Infrared: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
   b. Ultrasonic: Utilize an operating frequency of 32 kHz or 40 kHz, crystal-controlled to operate within plus/minus 0.005 percent tolerance.
   c. Ceiling-Mounted Sensors: Provide customizable mask to block off unwanted viewing areas.
   d. Isolated Relay: Provide an internal additional isolated relay with Normally Open, Normally Closed, and Common outputs for use with HVAC control, Data Logging and other control options where indicated.

e. Integral Photocell: Provide an integral photocell with adjustable sensitivity to prevent lights from turning on when there is sufficient natural light where indicated.

f. Product(s), Without Isolated Relay and Integral Photocell:

1) Ceiling-Mounted Dual Technology Sensor, 500 square feet (46 sq m); Lutron Model LOS-CDT-500-WH; or Lutron Model ULOS-CDT-500-WH (BAA-Buy American Act Compliant)>>: Coverage of 500 square feet (46 sq m) with ceiling height of 8 to 12 feet (2.6 to 3.7 m); 180 degree field of view.

2) Ceiling-Mounted Dual Technology Sensor, 1000 square feet (93 sq m); << Lutron Model LOS-CDT-1000-WH; or Lutron Model ULOS-CDT-1000-WH (BAAA-Buy American Act Compliant)>>: Coverage of 1000 square feet (93 sq m) with ceiling height of 8 to 12 feet (2.6 to 3.7 m); 180 degree field of view.

3) Ceiling-Mounted Dual Technology Sensor, 2000 square feet (186 sq m); Lutron Model LOS-CDT-2000-WH; or Lutron Model ULOS-CDT-2000-WH (BAA-Buy American Act Compliant)>>: Coverage of 2000 square feet (186 sq m) with ceiling height of 8 to 12 feet (2.6 to 3.7 m); 360 degree field of view.

4) Wall-Mounted Dual Technology Sensor; << Lutron Model LOS-WDT-WH; or Lutron Model ULOS-WDT-WH (BAA-Buy American Act Compliant>>: Coverage of 1600 square feet (149 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 110 degree field of view.

g. Product(s), With Isolated Relay and Integral Photocell:

1) Ceiling-Mounted Dual Technology Sensor, 500 square feet (46 sq m); Lutron Model LOS-CDT-500R-WH; or Lutron Model ULOS-CDT-500R-WH (BAA-Buy American Act Compliant): Coverage of 500 square feet (46 sq m) with ceiling height of 8 to 12 feet (2.6 to 3.7 m); 180 degree field of view; with isolated relay and integral photocell.

2) Ceiling-Mounted Dual Technology Sensor, 1000 square feet (93 sq m); Lutron Model LOS-CDT-1000R-WH; or Lutron Model ULOS-CDT-1000R-WH (BAAA-Buy American Act Compliant)>>: Coverage of 1000 square feet (93 sq m) with ceiling height of 8 to 12 feet (2.6 to 3.7 m); 180 degree field of view; with isolated relay and integral photocell.

3) Ceiling-Mounted Dual Technology Sensor, 2000 square feet (186 sq m); << Lutron Model LOS-CDT-2000R-WH; or Lutron Model ULOS-CDT-2000R-WH (BAA-Buy American Act Compliant;Coverage of 2000 square

feet (186 sq m) with ceiling height of 8 to 12 feet (2.6 to 3.7 m); 360 degree field of view; with isolated relay and integral photocell.

4) Wall-Mounted Dual Technology Sensor; Lutron Model LOS-WDT-R-WH; or Lutron Model ULOS-WDT-R-WH (BAA-Buy American Act Compliant; Coverage of 1600 square feet (149 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 110 degree field of view; with isolated relay and integral photocell.

B. Sensor Power Packs:

1. Product(s):
   a. Lutron Model PP-120H Power Pack; or Lutron Model UPP-120H Power Pack (BAA-Buy American Act Compliant); 120 VAC power input/24 VDC, 100 mA power output.
   b. << Lutron Model PP-230H Power Pack; or Lutron Model UPP-230H Power Pack (BAA-Buy American Act Compliant)>>; 230 VAC power input/24 VDC, 100 mA power output.
   c. << Lutron Model PP-277H Power Pack; or Lutron Model UPP-277H Power Pack (BAA-Buy American Act Compliant)>>; 277 VAC power input/24 VDC, 100 mA power output.
   d. << Lutron Model PP-347H Power Pack; or Lutron Model UPP-347H Power Pack (BAA-Buy American Act Compliant)>>; 347 VAC power input/24 VDC, 100 mA power output.
   e. << Lutron Model PP-DV Power Pack; or Lutron Model UPP-DV Power Pack (BAA-Buy American Act Compliant)>>; 120-277 VAC power input/24 VDC, 100 mA power output.
   f. << Lutron Model PP-DV-M Power Pack; or Lutron Model UPP-DV-M Power Pack (BAA-Buy American Act Compliant)>>; 120-277 VAC power input (manual)/24 VDC, 100 mA power output.
   g. << Lutron Model PP-SH Power Pack; or Lutron Model UPP-SH Power Pack (BAA-Buy American Act Compliant)>>; control relay only (no power input/output); requires another power pack for power and counts as one of three sensors connected to a power pack.
2. Provide sensor power packs where required for power connection to sensors.
3. For ease of mounting, installation and future service, power pack(s) to be able to mount through a 1/2 inch knockout in a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Transformer to provide power to a minimum of three sensors.

4. Relay Contact Rating: 20 A ballast (120/277 V); 15 A incandescent (120 V).
5. Plenum-rated.
6. Control Wiring Between Sensors and Control Units: Class 2, 18-24 AWG, stranded UL Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.

C. Infrared Receivers:
1. Product: Lutron Model EC-IR-WH.
2. Use Class 2 wiring for low voltage communication.
3. Can be replaced without reprogramming.
4. 360 degree reception of wireless infrared remote controls.
5. Immediate local LED response upon reception of handheld transmitter communication.
6. Mountable on lighting fixtures or recessed acoustical ceiling tiles.
7. Constructed via sonic welding.
8. Color: White.

D. Wired Daylight Sensors:
1. Digital Interior Daylight Sensor:
a. Product: Lutron Model EC-DIR-WH.
b. Use Class 2 wiring for low voltage communication.
c. Can be replaced without reprogramming.
d. Open-loop basis for daylight sensor control scheme.
e. Stable output over temperature from 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C).
f. Partially shielded for accurate detection of available daylight to prevent fixture lighting and horizontal light component from skewing sensor detection.
g. Provide linear response from 0 to 500 footcandles.
h. Integral IR receiver for personal control.
i. Mountable on lighting fixtures or recessed acoustical ceiling tiles.
j. Constructed via sonic welding.
k. Color: White.
2. Daylight Control Package:
a. Product: Lutron CES Series (Lutron CES Analog Sensor, LC8 Controller, and Power Pack).
b. Controller:
1) Product: Lutron Model LC8.
2) Automatically switches a dry contact according to changes in ambient light levels.

3) Fully adjustable separate high and low setpoints, with an adjustable dead band between set points to prevent unwanted cycling.
4) Input time delay to prevent unwanted cycling due to intermittent light level fluctuations.
5) Signal/setpoint and relay status indication.
6) Sensor calibration input.

c. Sensors:
1) Class 2, three-wire analog devices.
2) Provision for zero or offset based signal.
3) Indoor Photo Sensors; Lutron Model CES/I: With fresnel lens and 60 degree cone of response; sensor range of 0 to 750 footcandles.
4) Outdoor Photo Sensors; Lutron Model CES/O: Weatherproof, with hood over aperture to shield sensor from direct sunlight; sensor range of 0 to 750 footcandles.
5) Atrium Photo Sensors; Lutron Model CES/A: With translucent dome and 180 degree field of view; sensor range of 2 to 2,500 footcandles.
6) Skylight Photo Sensors; Lutron Model CES/S: With translucent dome and 180 degree field of view; sensor range of 10 to 7,500 footcandles.

E. Infrared Partition Sensors:
1. Product: Lutron Model GRX-IRPS-WH.
2. Provide contact closure based on status of the partition wall (open/close) enabling automatic linking of controls.

2.14 WIRELESS SENSORS

A. General Requirements:
1. Operational life of 10 years without the need to replace batteries when installed per manufacturer's instructions.
2. Communicates directly to compatible RF receiving devices through use of a radio frequency communications link.
3. Does not require external power packs, power wiring, or communication wiring.
4. Capable of being placed in test mode to verify correct operation from the face of the unit.
5. RF Range: 30 feet (9 m) between sensor and compatible RF receiving device(s).
6. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of CFR, Title 47, Part 15, for Class B application.

B. Wireless Occupancy/Vacancy Sensors:
1. General Requirements:

a. Provides a clearly visible method of indication to verify that motion is being detected during testing and that the unit is communicating to compatible RF receiving devices.
b. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
c. Sensing Mechanism: Passive infrared coupled with technology for sensing fine motions; Lutron XCT Technology. Signal processing technology detects fine-motion passive infrared (PIR) signals without the need to change the sensor's sensitivity threshold.
d. Provide optional, readily accessible, user-adjustable controls for timeout, automatic/manual-on, and sensitivity.
e. Turns off lighting after reasonable and adjustable time delay once the last person to occupy the space vacates a room or area. Provide adjustable timeout settings of 1, 5, 15, and 30 minutes.
f. Capable of turning dimmer's lighting load on to an optional locked preset level selectable by the user. Locked preset range to be selectable on the dimmer from 1 percent to 100 percent.
g. Color: White.
h. Provide all necessary mounting hardware and instructions for both temporary and permanent mounting.
i. Provide temporary mounting means to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method to be design for easy, damage-free removal.
j. Sensor lens to illuminate during test mode when motion is detected to allow installer to verify coverage prior to permanent mounting.
k. Ceiling-Mounted Sensors:
    1) Provide surface mounting bracket compatible with drywall, plaster, wood, concrete, and compressed fiber ceilings.
    2) Provide recessed mounting bracket compatible with drywall and compressed fiber ceilings.
    3) Provide customizable mask to block off unwanted viewing areas.
l. Wall-Mounted Sensors: Provide wall or corner mounting brackets compatible with drywall and plaster walls.

2. Wireless Combination Occupancy/Vacancy Sensors:
    a. Ceiling-Mounted Sensors: Programmable to operate as an occupancy sensor (automatic-on and automatic-off), an occupancy sensor with low light feature

(automatic-on when less than one footcandle of ambient light available and automatic-off), or a vacancy sensor (manual-on and automatic-off).

b. Wall-Mounted Sensors: Programmable to operate as an occupancy sensor (automatic-on and automatic-off), or a vacancy sensor (manual-on and automatic-off).

c. Product(s):

1) Ceiling-Mounted Occupancy/Vacancy Sensor; << Lutron Radio Powr Savr Series, Model LFR2-OCR2B-P-WH; or Lutron Radio Powr Savr Series, Model ULFR2-OCR2B-P-WH (BAA-Buy American Act Compliant)>>: Coverage from 324 square feet (30.2 sq m) to 676 square feet (62.4 sq m) depending on ceiling height from 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view.

2) Wall-Mounted Occupancy/Vacancy Sensor; << Lutron Radio Powr Savr Series, Model LFR2-OWLB-P-WH; or Lutron Radio Powr Savr Series, Model ULFR2-OWLB-P-WH (BAA-Buy American Act Compliant)>>: Minor motion coverage of 1500 square feet (139.4 sq m) and major motion coverage of 3000 square feet (278.7 sq m) with mounting height of 6 to 8 feet (1.6 to 2.4 m); 180 degree field of view.

3) Corner-Mounted Occupancy/Vacancy Sensor; << Lutron Radio Powr Savr Series, Model LFR2-OKLB-P-WH; or Lutron Radio Powr Savr Series, Model ULFR2-OKLB-P-WH (BAA-Buy American Act Compliant)>>: Minor motion coverage of 1225 square feet (113.8 sq m) and major motion coverage of 2500 square feet (232.3 sq m) with mounting height of 6 to 8 feet (1.6 to 2.4 m); 90 degree field of view.

4) Hallway Occupancy/Vacancy Sensor; << Lutron Radio Powr Savr Series, Model LFR2-OHLB-P-WH; or Lutron Radio Powr Savr Series, Model ULFR2-OHLB-P-WH (BAA-Buy American Act Compliant)>>: Major motion coverage of up to 150 feet (45.7 m) with mounting height of 6 to 8 feet (1.6 to 2.4 m); narrow field of view.

3. Wireless Vacancy-Only Sensors:

a. Operates only as a vacancy sensor (manual-on and automatic-off)<< in accordance with California Title 24 requirements>>.

b. Product(s):

1) Ceiling-Mounted Vacancy-Only Sensor; << Lutron Radio Powr Savr Series, Model LFR2-VCR2B-P-WH; or Lutron Radio Powr Savr Series, Model ULFR2-VCR2B-P-WH (BAA-Buy American Act Compliant)>>: Coverage from 324 square feet (30.2 sq m) to 676 square feet (62.4 sq

m) depending on ceiling height from 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view.

2) Wall-Mounted Vacancy-Only Sensor; << Lutron Radio Powr Savr Series, Model LFR2-VWLB-P-WH; or Lutron Radio Powr Savr Series, Model ULFR2-VWLB-P-WH (BAA-Buy American Act Compliant)>>: Minor motion coverage of 1500 square feet (139.4 sq m) and major motion coverage of 3000 square feet (278.7 sq m) with mounting height of 6 to 8 feet (1.6 to 2.4 m); 180 degree field of view.

3) Corner-Mounted Vacancy-Only Sensor; << Lutron Radio Powr Savr Series, Model LFR2-VKLB-P-WH; or Lutron Radio Powr Savr Series, Model ULFR2-VKLB-P-WH (BAA-Buy American Act Compliant)>>: Minor motion coverage of 1225 square feet (113.8 sq m) and major motion coverage of 2500 square feet (232.3 sq m) with mounting height of 6 to 8 feet (1.6 to 2.4 m); 90 degree field of view.

4) Hallway Vacancy-Only Sensor; << Lutron Radio Powr Savr Series, Model LFR2-VHLB-P-WH; or Lutron Radio Powr Savr Series, Model ULFR2-VHLB-P-WH (BAA-Buy American Act Compliant)>>: Major motion coverage of up to 150 feet (45.7 m) with mounting height of 6 to 8 feet (1.6 to 2.4 m); narrow field of view.

C. Wireless Daylight Sensors:

1. Product: Lutron Model LFR2-DCRB.
2. Open-loop basis for daylight sensor control scheme.
3. Stable output over temperature from 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C).
4. Partially shielded for accurate detection of available daylight to prevent fixture lighting and horizontal light component from skewing sensor detection.
5. Provide linear response from 0 to 10,000 footcandles.
6. Color: White.
7. Mounting:
   a. Provide surface mounting bracket compatible with drywall, plaster, wood, concrete, and compressed fiber ceilings.
   b. Provide all necessary mounting hardware and instructions for both temporary and permanent mounting.
   c. Provide temporary mounting means to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method to be design for easy, damage-free removal.
8. Meets California Title 24 requirements.

2.15 ACCESSORIES

A. Emergency Lighting Interface:

1. Product: Lutron Model LUT-ELI.
2. Provides total system listing to UL 924 when used with lighting control system.
3. Senses all three phases of building power.
4. Provides an output to power panels or digital ballast interfaces if power on any phase fails and sends all lights controlled by these devices to <<an emergency light level setting; 100 percent intensity; Lights to return to their previous intensities when normal power is restored.
5. Accepts a contact closure input from a fire alarm control panel.

B. Provide power supplies as indicated or as required to power system devices and accessories.

1. Product(s):
   a. Junction box-mounted power supply for shades, keypads, and accessories, and for providing additional low voltage power to communication link; Lutron Model QSPS-J-1-50; with miswire and thermal protection.
   b. Plug-in power supply for shades, drapery drive units, keypads, and accessories, and for providing additional low voltage power to communication link; Lutron Model QSPS-P1-1-50; with miswire protection; powered from standard receptacle using cord 6 feet (1.8 m) in length.
   c. Ten output power supply panel for shades, drapery drive units, keypads and accessories, and for providing additional low voltage power to communication link; Lutron Model QSPS-P1-10-60.
   d. Power supply for keypads and accessories (not for shades/window treatments), and for providing additional low voltage power to communication link; Lutron Model STEP-PS.

2.16 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Factory Testing; Lutron Standard Factory Testing:

1. Perform full-function factory testing on all completed assemblies. Statistical sampling is not acceptable.
2. Perform full-function factory testing on 100 percent of all ballasts and LED drivers.
3. Perform factory audit burn-in of all dimming assemblies and panels at 104 degrees F (40 degrees C) at full load for two hours.
4. Perform factory burn-in of 100 percent of all ballasts at 104 degrees F (40 degrees C).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that ratings and configurations of system components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive system components.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA Install products in accordance with manufacturer's instructions.

B. Provide dedicated network between lighting management system computer and lighting management hubs.

C. Define each dimmer/relay load type, assign each load to a zone, and set control functions.

D. Sensor Locations:

1. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", locate sensors in accordance with layout provided by Lighting Control Manufacturer. Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated. Where Lighting Control Manufacturer Sensor Layout and Tuning service is not specified, locate sensors in accordance with Drawings.
2. Sensor locations indicated are diagrammatic. Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage, in accordance with manufacturer's recommendations.

E. Mount exterior daylight sensors to point due north with constant view of daylight.

F. Ensure that daylight sensor placement minimizes sensor view of electric light sources. Locate ceiling-mounted and luminaire-mounted daylight sensors to avoid direct view of luminaires.

G. Automated Shade Control Sensors:

1. Mount rooftop cloudy day sensors to point in the direction of each facade.
2. Ensure that window shadow sensor placement provides an unobstructed view of outdoors. Do not place at a skylight or above indirect luminaires.

H. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

I. Lamp Lead Lengths: Do not exceed 3 feet (0.9 m) for T4 4-pin compact and T5 BIAX lamps and 7 feet (2.1 m) for T5, T5-HO, T8 U-bend, and T8 linear fluorescent lamps.

J. LED Light Engine/Array Lead Length: Do not exceed 100 feet (31 m).

K. System and Network Integration Consultation; Lutron LSC-INT-VISIT: Include <<as part of the base bid additional costs for Lighting Control Manufacturer to conduct meeting with facility representative and other related equipment manufacturers to discuss equipment and integration procedures.

1. Coordinate scheduling of visit with Lighting Control Manufacturer. Manufacturer recommends that this visit be scheduled early in construction phase, after system purchase but prior to system installation.

L. Identify system components in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Manufacturer's Startup Services; Lutron Standard Startup Services:

1. Manufacturer's authorized Service Representative to conduct minimum of two site visits to ensure proper system installation and operation.
2. Conduct Pre-Installation visit to review requirements with installer as specified in Part 1 under "Administrative Requirements".
3. Conduct second site visit upon completion of lighting control system to perform system startup and verify proper operation:
    a. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under “DIGITAL-NETWORK LIGHTING CONTROL SYSTEM – GENERAL REQUIREMENTS”, authorized Service Representative to verify sensor locations, in accordance with layout provided by Lighting Control Manufacturer; Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated.
    b. Verify connection of power wiring and load circuits.
    c. Verify connection and location of controls.
    d. Energize lighting management hubs and download system data program.
    e. Address devices.
    f. Verify proper connection of panel links (low voltage/data) and address panel.
    g. Download system panel data to dimming/switching panels.
    h. Check dimming panel load types and currents and supervise removal of by-pass jumpers.
    i. Verify system operation control by control.
    j. Verify proper operation of manufacturer's interfacing equipment.
    k. Verify proper operation of manufacturer's supplied PC and installed programs.
    l. Configure initial groupings of ballast for wall controls, daylight sensors and occupancy sensors.

m. Provide initial rough calibration of sensors; fine-tuning of sensors is responsibility of Contractor unless provided by Lighting Control Manufacturer as part of Sensor Layout and Tuning service where specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS".

n. Train Owner's representative on system capabilities, operation, and maintenance, as specified in Part 3 under "Closeout Activities".

o. Obtain sign-off on system functions.

p. After Hours Startup; Lutron LSC-AH-SU: Include as part of the base bid additional costs to perform manufacturer's startup procedures outside normal working hours (Monday through Friday, 7am to 5pm).

C. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

3.04 ADJUSTING

A. On-Site Scene and Level Tuning; Lutron LSC-AF-VISIT: Include as part of the base bid additional costs for Lighting Control Manufacturer to visit site to conduct meeting with Engineer; Owner's representative;to make required lighting adjustments to the system for conformance with original design intent.

B. Sensor Fine-Tuning: Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under “DIGITAL-NETWORK LIGHTING CONTROL SYSTEM – GENERAL REQUIREMENTS”, Lighting Control Manufacturer to provide up to two additional post-startup on-site service visits for fine-tuning of sensor calibration. Where Lighting Control Manufacturer Sensor Layout and Tuning service is not specified, Contractor to provide fine-tuning of sensor calibration.

3.05 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.06 COMMISSIONING

A. See Section 01 9113 for commissioning requirements.

3.07 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

C. Demonstration:

1. On-Site Performance-Verification Walkthrough; Lutron LSC-WALK: Include as part of the base bidadditional costs for lighting control manufacturer to provide on-site demonstration of system functionality to facility manager

D. Training:

1. Include services of manufacturer's authorized Service Representative to perform on-site training of Owner's personnel on operation, adjustment, and maintenance of lighting control system as part of standard system start-up services.
    a. Include training on software to be provided:
        1) Configuration software used to make system programming and configuration changes.
        2) Control and monitor.
        3) Energy savings display software.
        4) Personal web-based control software.
2. Customer-Site Solution Training Visit; Lutron LSC-TRAINING: Include as part of the base bidadditional costs for Lighting Control Manufacturer to provide two of additional on-site system training.

3.08 PROTECTION

A. Protect installed products from subsequent construction operations.

3.09 MAINTENANCE

A. See Section 01 7000 - Execution Requirements, for additional requirements relating to maintenance service.

B. Software Maintenance Agreement; Lutron LSC-SMA: Include as part of the base bid additional costs for manufacturer to provide quarterly compatibility testing results for PC-based lighting control software and new patches issued for Microsoft Operating System, Database, and Browser tools.
    1. If new Microsoft patches create a software conflict, manufacturer to provide lighting control software patches to ensure continued operation.

C. System Optimization Visit; Lutron LSC-SYSOPT: Include as part of the base bid additional costs for Lighting Control System Manufacturer to visit site six months after system start-up to evaluate system usage and discuss opportunities to make efficiency improvements that will fit with the current use of the facility.

END OF SECTION 260943

SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.
2. Control and Signal transformers.

1.3 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Qualification Data: For testing agency.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Products.
2. General Electric Company.
3. Siemens Energy & Automation, Inc.
4. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Aluminum or Copper.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Enclosure: Ventilated, NEMA 250, Type 2.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

D. Enclosure: Ventilated, NEMA 250, Type 3R.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

E. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: ANSI 49 gray ANSI 61 gray.

F. Taps for Transformers Smaller Than 3 kVA: One 5 percent tap above normal full capacity.

G. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

I. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

J. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with NEMA TP 1, Class 1 efficiency levels.
2. Tested according to NEMA TP 2.

K. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
2. Indicate value of K-factor on transformer nameplate.

L. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.

1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
2. Include special terminal for grounding the shield.
3. Shield Effectiveness:

a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.

M. Wall Brackets: Manufacturer's standard brackets.

N. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.4 CONTROL AND SIGNAL TRANSFORMERS

A. Description: Self-cooled, two-winding dry type, rated for continuous duty complyING with NEMA ST 1 and listed and labeled as complying with UL 506.

B. Ratings: Continuous duty. If rating is not indicated, provide at least 50 percent spare capacity above connected peak load.

2.5 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.6 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.5 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262200

SECTION 26 24 13 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Transient voltage suppression devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail utility company's metering provisions with indication of approval by utility company.
7. Include evidence of NRTL listing for series rating of installed devices.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
10. Include diagram and details of proposed mimic bus.
11. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Samples: Representative portion of mimic bus with specified material and finish, for color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified [Installer] [testing agency].

B. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

C. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Comply with NEMA PB 2.

G. Comply with NFPA 70.

H. Comply with UL 891.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Handle and prepare switchboards for installation according to [NECA 400] [NEMA PB 2.1].

1.9 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
    b. Altitude: Not exceeding 6600 feet (2000 m).

C. Service Conditions: NEMA PB 2, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Comply with NFPA 70E.

1.10 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: [Five] <Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.

B. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

C. Nominal System Voltage: 480Y/277 V.

D. Main-Bus Continuous: As shown on plans.

E. Indoor Enclosures: Steel, NEMA 250, Type 1.

F. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

G. Cubical Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.

1. Space-Heater Control: Thermostats to maintain temperature of each section above expected dew point.
2. Space-Heater Power Source: Transformer, factory installed in switchboard.

H. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

I. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

J. Pull Box on Top of Switchboard:

1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
2. Set back from front to clear circuit-breaker removal mechanism.
3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

K. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated, or copper feeder circuit-breaker line connections.
2. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
3. Ground Bus: 1/4-by-2-inch- hard-drawn copper of 98 percent conductivity, equipped with connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
4. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
5. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.

L. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

M. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

2.2 TRANSIENT VOLTAGE SUPPRESSION DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, wired-in solid-state, parallel-connected, type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:

1. Fuses, rated at 200-kA interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring.
3. Integral disconnect switch.
4. Redundant suppression circuits.

5. Redundant replaceable modules.
6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
7. LED indicator lights for power and protection status.
8. Audible alarm, with silencing switch, to indicate when protection has failed.
9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
10. Four digit, transient-event counter set to totalize transient surges.

C. Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 kA per phase.

D. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.

E. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277-V, three-phase, four-wire circuits shall be as follows:

1. Line to Neutral: 800 V for 480Y/277.
2. Line to Ground: 800 V for 480Y/277.
3. Neutral to Ground: 800 V for 480Y/277.

F. Protection modes and UL 1449 SVR for 240/120-V, three-phase, four-wire circuits with high leg shall be as follows:

1. Line to Neutral: 400 V, 800 V from high leg.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB) Main and branch: Comply with UL 489, with interrupting capacity to meet available fault currents as indicated on drawings.

1. Thermal-Magnetic Circuit Breakers: Breakers 400 ampere frame and less shall be manufacturer's standard industrial construction bolt-on type, integral inverse time delay thermal and instantaneous magnetic trip. Breakers 225 ampere through 400 ampere shall have continuously adjustable magnetic pick-ups of approximately five to ten times trip rating.
2. Electronic trip circuit breakers 600 ampere frame and above shall be equipped with solid-state trip complete with built-in current transformers, solid-state trip unit and flux transfer shunt trip. Field-replicable electronic trips shall have the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response. (Main breaker above 1000A and branch breakers 1200 A and above)

3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
4. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.

5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

B. GROUND FAULT RELAYING.
1. Provide ground fault protection on each disconnect device, rated 1200 amps or above.
2. Provide U.L. listed ground fault relay system with coordinated ground sensor with integral test winding and solid state relay to operate with protective device shunt trip circuit and monitor panel.
3. Use time delay type relay or breaker electronics to provide the following features:
    a. Continuously adjustable current pick-up settings of 100 to 1200 amperes.
    b. Continuously adjustable time delay setting from instantaneous (.03 seconds) to one second.
    c. Memory function to recognize and initiate tripping on intermittent ground faults.

4. Install panel that indicates relay operation and provides means for testing the system with or without interruption of electric service and does not permit the ground fault system to be inadvertently left in an inactive or "off" state.

C. Insulated-Case Circuit Breaker (ICCB): 100 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.

1. Fixed circuit-breaker mounting.
2. Two-step, stored-energy closing.
3. Standard-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time time adjustments.
    c. Ground-fault pickup level, time delay, and I^2t response.

4. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
5. Remote trip indication and control.
6. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
8. Control Voltage: 120-V ac.

2.4 INSTRUMENTATION

A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:

1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
2. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
3. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

B. Multifunction Digital-Metering Monitor: Main bus shall be furnished with microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

   a. Phase Currents, Each Phase: Plus or minus 1 percent.
   b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
   c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
   d. Megawatts: Plus or minus 2 percent.
   e. Megavars: Plus or minus 2 percent.
   f. Power Factor: Plus or minus 2 percent.
   g. Frequency: Plus or minus 0.5 percent.
   h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
   i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
   j. Contact devices to operate remote impulse-totalizing demand meter.

2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door. Maximum mounting height 60" above base of switchboard.

2.5 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

C. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

2.6 IDENTIFICATION

A. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on a photoengraved nameplate.

1. Nameplate: At least 0.032-inch- (0.813-mm-) thick anodized aluminum, located at eye level on front cover of the switchboard incoming service section.

B. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on an engraved laminated-plastic (Gravoply) nameplate.

1. Nameplate: At least 0.0625-inch- (1.588 mm-) thick laminated plastic (Gravoply), located at eye level on front cover of the switchboard incoming service section.

C. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram.

D. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.

E. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.

F. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to switchboards.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

F. Install filler plates in unused spaces of panel-mounted sections.

G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges per coordination study.

H. Install spare-fuse cabinet.

I. Comply with NECA 1.

3.3 CONNECTIONS

A. Comply with requirements for terminating feeder bus specified in Division 26 Section "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.

B. Comply with requirements for terminating cable trays specified in Division 26 Section "Cable Trays for Electrical Systems." Drawings indicate general arrangement of cable trays, fittings, and specialties.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
   c. Instruments and Equipment:

      1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Switchboard will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Load centers.
4. Electronic-grade panelboards.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. TVSS: Transient voltage surge suppressor.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.
1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.5 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Reports:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
   2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Keys: Two spares for each type of panelboard cabinet lock.
   2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   3. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.10 PROJECT CONDITIONS

A. Environmental Limitations:
   1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
   2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
      a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
      b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
   1. Ambient temperatures within limits specified.
   2. Altitude not exceeding 6600 feet (2000 m).

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify Owner no fewer than two days in advance of proposed interruption of electric service.
   2. Comply with NFPA 70E.

1.11 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.12 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: Flush- and surface-mounted cabinets.
   1. Rated for environmental conditions at installed location.
      a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
      b. Outdoor Locations: NEMA 250, Type 3R.
      c. KitchenWash-Down Areas: NEMA 250
      d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
      e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
   2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
   3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
   4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
   5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
   6. Finishes:
      a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
      b. Back Boxes: Galvanized steel.
   7. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.

C. Incoming Mains Location: As required.

D. Phase, Neutral, and Ground Buses:
   1. Material: Hard-drawn copper, 98 percent conductivity.
   2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
   3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.

4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
5. Split Bus: Vertical buses divided into individual vertical sections.

E. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
6. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.

I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
1. For doors more than [36 inches (914 mm)] high, provide two latches, keyed alike.

D. Mains: As indicated.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

G. Branch Overcurrent Protective Devices: Fused switches.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   3. Siemens Energy & Automation, Inc.
   4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Door shall be available to open over breaker lugs.

2.4 LOAD CENTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   3. Siemens Energy & Automation, Inc.
   4. Square D; a brand of Schneider Electric.

B. Mains: As indicated.

C. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

D. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.5 ELECTRONIC-GRADE PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1.
   2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

4. Siemens Energy & Automation, Inc.
5. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1; with factory-installed, integral TVSS; labeled by an NRTL for compliance with UL 67 after installing TVSS.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

D. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

E. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

F. Buses:
1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.
2. Copper equipment and isolated ground buses.

G. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, bolt-on, solid-state, parallel-connected, type, with sine-wave tracking suppression and filtering modules, short-circuit current rating complying with UL 1449, second edition, and matching or exceeding the panelboard short-circuit rating, redundant suppression circuits, with individually fused metal-oxide varistors.
1. Accessories:
   a. Fuses rated at 200-kA interrupting capacity.
   b. Fabrication using bolted compression lugs for internal wiring.
   c. Integral disconnect switch.
   d. Redundant suppression circuits.
   e. Redundant replaceable modules.
   f. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
   g. LED indicator lights for power and protection status.
   h. Audible alarm, with silencing switch, to indicate when protection has failed.
   i. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
   j. Four-digit, transient-event counter set to totalize transient surges.
2. Peak Single-Impulse Surge Current Rating: 120 kA per mode/240 kA per phase.
3. Minimum single-impulse current ratings, using 8-by-20-mic.sec. waveform described in IEEE C62.41.2.
   a. Line to Neutral: 70,000 A.
   b. Line to Ground: 70,000 A.
   c. Neutral to Ground: 50,000 A.
4. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
5. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277 208Y/120 -V, three-phase, four-wire circuits shall be as follows:
   a. Line to Neutral: 800 V for 480Y/277 400 V for 208Y/120.
   b. Line to Ground: 800 V for 480Y/277 400 V for 208Y/120.
   c. Neutral to Ground: 800 V for 480Y/277 400 V for 208Y/120.

6. Protection modes and UL 1449 SVR for 240-, 480-, or 600-V, three-phase, three-wire, delta circuits shall be as follows:
   a. Line to Line: 2000 V for 480 V 1000 V for 240 V.
   b. Line to Ground: 1500 V for 480 V 800 V for 240 V.

2.6 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   3. Siemens Energy & Automation, Inc.
   4. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and I^2t response.
   4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
   5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
   6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
   7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
   8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
      a. Standard frame sizes, trip ratings, and number of poles.
      b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
      c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
      d. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
      e. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.7 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Equipment Mounting: Install panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete"
   1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
   2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   4. Install anchor bolts to elevations required for proper attachment to panelboards.
   5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

F. Install overcurrent protective devices and controllers not already factory installed.
   1. Set field-adjustable, circuit-breaker trip ranges.

G. Install filler plates in unused spaces.

H. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

I. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

J. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

E. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   3. Perform the following infrared scan tests and inspections and prepare reports:
      a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
      b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
      c. Instruments and Equipment:
         1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

F. Panelboards will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
   1. Measure as directed during period of normal system loading.
   2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
   3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
   4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Receptacles, receptacles with integral GFCI, and associated device plates.
   2. Twist-locking receptacles.
   3. Wall-box motion sensors.
   4. Isolated-ground receptacles.
   5. Hospital-grade receptacles.
   6. Snap switches and wall-box dimmers.
   7. Solid-state fan speed controls.
   8. Wall-switch and exterior occupancy sensors.
   9. Communications outlets.
   10. Pendant cord-connector devices.
   11. Cord and plug sets.
   12. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

B. Related Sections include the following:
   1. Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Field quality-control test reports. Submitted prior to final punch list.

D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

E. Submit on digital wiring analyzer to be used to test voltage drop on receptacles.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
   1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
   1. Arrow Hart/Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
   2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
   3. Leviton Mfg. Company Inc. (Leviton).
   4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).
   5. Hubbell Building Automation Systems.

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; 5351 (single), 5352 (duplex).
      b. Hubbell; HBL5351 (single), CR5352 (duplex).
      c. Leviton; 5891 (single), 5352 (duplex).
      d. Pass & Seymour; 5381 (single), 5352 (duplex).

B. Hospital-Grade, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498 Supplement SD.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; 8300 (duplex).
      b. Hubbell; HBL8310 (single), HBL8300H (duplex).
      c. Leviton; 8310 (single), 8300 (duplex).
      d. Pass & Seymour; 9301-HG (single), 9300-HG (duplex).

C. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Hubbell; CR 5253IG.
      b. Leviton; 5362-IG.
      c. Pass & Seymour; IG6300.
   3. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

D. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; TR8300.
      b. Hubbell; HBL8300SG.
      c. Leviton; 8300-SGG.
      d. Pass & Seymour; 63H.
   2. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; GF20.
      b. Pass & Seymour; 2084.

C. Hospital-Grade, Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with UL 498 Supplement SD.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; HGF20.
      b. Hubbell; HGF8300.
      c. Leviton; 6898-HG.
      d. Pass & Seymour; 2091-SHG.

2.4 TVSS RECEPTACLES

A. Isolated-Ground, Duplex Convenience Receptacles:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; IG5362BLS.
      b. Hubbell; IG5362SA.
      c. Leviton; 5380-IG.
   3. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

B. Hospital-Grade, Duplex Convenience Receptacles: Comply with UL 498 Supplement SD.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; 8300BLS.
      b. Hubbell; HBL8362SA.
      c. Leviton; 8380.
   3. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R.

C. Isolated-Ground, Hospital-Grade, Duplex Convenience Receptacles:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; IG8300HGBLS.
   b. Hubbell; IG8362SA.
   c. Leviton; 8380-IG.
3. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R. Comply with UL 498 Supplement SD. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.5 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Cooper Crouse-Hinds.
      b. EGS/Appleton Electric.
      c. Killark; a division of Hubbell Inc.

2.6 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; L520R.
      b. Hubbell; HBL2310.
      c. Leviton; 2310.
      d. Pass & Seymour; L520-R.

B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Hubbell; IG2310.
      b. Leviton; 2310-IG.
   3. Description: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.7 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.
   1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
   2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.8 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
   1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
   2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.9 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
      b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
      c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
      d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

C. Pilot Light Switches, 20 A:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; 2221PL for 120 V and 277 V.
      b. Hubbell; HPL1221PL for 120 V and 277 V.
      c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
      d. Pass & Seymour; PS20AC1-PLR for 120 V.
   3. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277 V, 20 A:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; 2221L.
   b. Hubbell; HBL1221L.
   c. Leviton; 1221-2L.
   d. Pass & Seymour; PS20AC1-L.
3. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; 1995.
   b. Hubbell; HBL1557.
   c. Leviton; 1257.
   d. Pass & Seymour; 1251.

F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; 1995L.
   b. Hubbell; HBL1557L.
   c. Leviton; 1257L.
   d. Pass & Seymour; 1251L.

2.10 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
1. 600 W; dimmers shall require no derating when ganged with other devices.
2. Dimmers greater than 600 watts shall have cooling fans with back box to match spacing.

D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.11 OCCUPANCY SENSORS

A. Wall-Switch Sensors:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; 6111 for 120 V, 6117 for 277 V.
   b. Hubbell; WS1277.
   c. Leviton; ODS 10-ID.
   d. Pass & Seymour; WS3000.
   e. Watt Stopper (The); WS-200.
3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

B. Wall-Switch Sensors:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
   a. Hubbell; AT120 for 120 V, AT277 for 277 V.
   b. Leviton; ODS 15-ID.
3. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

C. Dual Level Wall-Switch Sensors with Photocell:
1. Subject to compliance with requirements
   a. Hubbell Building Automation; LHMTD2W
2. Description: Intelligent self-adapting occupancy sensor.

D. Long-Range Wall-Switch Sensors:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
   a. Hubbell; ATP1600WRP.
   b. Leviton; ODWWV-IRW.
   c. Pass & Seymour; WA1001.
   d. Watt Stopper (The); CX-100.
3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft. (111 sq. m).

E. Long-Range Wall-Switch Sensors:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
   a. Hubbell; ATD1600WRP.
   b. Leviton; ODW12-MRW.
   c. Watt Stopper (The); DT-200.

3. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of 1200 sq. ft. (111 sq. m).

F. Wide-Range Wall-Switch Sensors:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
   a. Hubbell; ATP120HBRP.
   b. Leviton; ODWHB-IRW.
   c. Pass & Seymour; HS1001.
   d. Watt Stopper (The); CX-100-3.
3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of 1200 sq. ft. (111 sq. m).

G. Exterior Occupancy Sensors:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
   a. Leviton; PS200-10.
   b. Watt Stopper (The); EW-100-120.
3. Description: Passive-infrared type, 120/277 V, weatherproof, adjustable time delay up to 15 minutes, 180-degree field of view, and 110-foot (34-m) detection range. Minimum switch rating: 1000-W incandescent, 500-VA fluorescent.

2.12 COMMUNICATIONS OUTLETS

A. Telephone Outlet:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; 3560-6.
   b. Leviton; 40649.
3. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e. Comply with UL 1863.

B. Combination TV and Telephone Outlet:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; 3562.
   b. Leviton; 40595.
3. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e; and one Type F coaxial cable connector.

2.13 WALL PLATES

A. Single and combination types to match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces: Smooth, high-impact thermoplastic 0.035-inch- (1-mm-) thick or satin-finished stainless steel 0.04-inch- (1-mm-) thick, brushed brass with factory polymer finish [0.05-inch- (1.2-mm-) thick anodized aluminum] [0.04-inch- (1-mm-) thick steel with chrome-plated finish].
   3. Material for Unfinished Spaces: Galvanized steel.
   4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant , die-cast aluminum with lockable cover.

2.14 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, solid brass with satin finish.

D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 Category 5e or Category 6 jacks for UTP cable. Verify exact jack requirements with telecommunication specifications.

2.15 POKE-THROUGH ASSEMBLIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hubbell Incorporated; Wiring Device-Kellems.
   2. Pass & Seymour/Legrand; Wiring Devices & Accessories.
   3. Square D/ Schneider Electric.
   4. Thomas & Betts Corporation.
   5. Wiremold Company (The).

C. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
   1. Service Outlet Assembly: Pedestal type with services indicated.
   2. Size: Selected to fit nominal 3-inch (75-mm) or 4-inch (100-mm)] cored holes in floor and matched to floor thickness.
   3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.

4. Closure Plug: Arranged to close unused 3-inch (75-mm) or 4-inch (100-mm)] cored openings and reestablish fire rating of floor.
5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of [four], 4-pair, Category 3, Category 5e or Category 6 voice and data communication cables. Verify with owner and telecommunication specifications.

2.16 MULTIOUTLET ASSEMBLIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Incorporated; Wiring Device-Kellems.
2. Wiremold Company (The).

C. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

D. Raceway Material: Metal, with manufacturer's standard finish.

E. Wire: No. 12 AWG.

2.17 SERVICE POLES

A. Description: Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.
1. Poles: Nominal 2.5-inch- (65-mm-) square cross section, with height adequate to extend from floor to at least 6 inches (150 mm) above ceiling, and with separate channels for power wiring and voice and data communication cabling.
2. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
3. Finishes: Manufacturer's standard painted finish and trim combination.
4. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, 4-pair, Category 6 or 5 voice and data communication cables.
5. Power Receptacles: Two duplex, 20-A, heavy-duty, NEMA WD 6 configuration 5-20R units or as indicated on plans.
6. Voice and Data Communication Outlets: As shown on plans.

2.18 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.
1. Wiring Devices Connected to Normal Power SystemAs selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:
1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:
1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles [up] [down], and on horizontally mounted receptacles to the [right] [left].
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:
1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings. Verify with Architect and Owner that all floor outlets and service poles are coordinated with furniture to be installed.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."
1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable. Report voltage drop on receptacle circuit as follows: Receptacle circuit L-1 (Typical) Voltage measured = 119V. All receptacle circuits shall be reported. Final close out of project will not be attained without report.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Test straight blade [convenience outlets in patient-care areas] [hospital-grade convenience outlets] for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).

END OF SECTION 262726

SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, panelboards, switchboards, enclosed controllers and motor-control centers.
   2. Spare-fuse cabinets.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
   1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
   2. Current-limitation curves for fuses with current-limiting characteristics.
   3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
   4. Fuse sizes for elevator disconnect switches.

B. Operation and Maintenance Data: For fuses to include in operation and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. Current-limitation curves for fuses with current-limiting characteristics.
   2. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses:
      a. Three spare of each size and type
      b. Fuse cabinet sized to contain spare fuse stock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cooper Bussmann, Inc.
   2. Ferraz Shawmut, Inc.
   3. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
   1. Size: Adequate for storage of spare fuses specified.
   2. Finish: Gray, baked enamel.
   3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
   4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:
   1. Service Entrance: Class L, time delay; Class J, time delay.
   2. Feeders: Class L, time delay [Class RK1, fast acting] [Class RK1, time delay] [Class RK5, fast acting] [Class RK5, time delay] [Class J, fast acting] [Class J, time delay].
   3. Motor Branch Circuits: Class RK.
   4. Other Branch Circuits: Class RK1, time delay; Class J, time delay.
   5. Control Circuits: Class CC, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Fusible switches.
   2. Nonfusible switches.
   3. Molded-case circuit breakers (MCCBs).
   4. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
   1. Enclosure types and details for types other than NEMA 250, Type 1.
   2. Current and voltage ratings.
   3. Short-circuit current ratings (interrupting and withstand, as appropriate).
   4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
   5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
   2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
   2. Altitude: Not exceeding 6600 feet (2010 m).

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide or product by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   3. Siemens Energy & Automation, Inc.
   4. Square D; a brand of Schneider Electric.
   5. Bussmann (Elevator Switch).

B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

C. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
3. For isolated grounded systems Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Hookstick Handle: Allows use of a hookstick to operate the handle.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:
   1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

SECTION 263213 - PACKAGED ENGINE GENERATOR

Part 1. GENERAL

1.01 Scope

A. Provide complete factory assembled generator set equipment with digital (microprocessor-based) electronic generator set controls, digital governor, and digital voltage regulator.

B. Provide factory test, startup by a supplier authorized by the equipment manufacturer(s), and on-site testing of the system.

C. The generator set manufacturer shall warrant all equipment provided under this section, whether or not is manufactured by the generator set manufacturer, so that there is one source for warranty and product service. Technicians specifically trained and certified by the manufacturer to support the product and employed by the generator set supplier shall service the generator sets.

1.02 Codes and Standards

A. The generator set installation and on-site testing shall conform to the requirements of the following codes and standards, as applicable. The generator set shall include necessary features to meet the requirements of these standards.

1. CSA 282, 1989 Emergency Electrical Power Supply for Buildings
2. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
3. NFPA37 –
4. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
5. NFPA99 – Essential Electrical Systems for Health Care Facilities
6. NFPA110 – Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.

B. The generator set and supplied accessories shall meet the requirements of the following standards:

1. NEMA MG1-1998 part 32. Alternator shall comply with the requirements of this standard.
2. UL142 – Sub-base Tanks
3. UL1236 – Battery Chargers
4. UL2200. The generator set shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed..

C. The control system for the generator set shall comply with the following requirements.

1. CSA C22.2, No. 14 – M91 Industrial Control Equipment.
2. EN50082-2, Electromagnetic Compatibility – Generic Immunity Requirements, Part 2: Industrial.
3. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
4. FCC Part 15, Subpart B.
5. IEC8528 part 4. Control Systems for Generator Sets
6. IEC Std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions.
7. UL508. The entire control system of the generator set shall be UL508 listed and labeled.
8. UL1236 –Battery Chargers.

D. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.03 Acceptable Manufacturers

Only approved bidders shall supply equipment provided under this contract. Equipment specifications for this project are based on generator sets manufactured by Cummins Power Generation Generac and Caterpillar with microprocessor-based controls. Equipment by other suppliers that meets the requirement of this specification are acceptable, if approved not less than 2 weeks before scheduled bid date. Proposals must include a line by line compliance statement based on this specification.

Part 2. PRODUCTS

2.01 Generator set

A. **Ratings**

1. The generator set shall operate at 1800 rpm and at a voltage of: 480 Volts AC, Three phase, 4-wire, 60 hertz.

2. The generator set shall be rated as (voltage and current rating as shown on plans), emergency standby rating, based on site conditions of : Altitude 100 ft. (30.48 meters), ambient temperatures up to 104 degrees F (40 degrees C).
3. The generator set rating shall be based on emergency/standby service.

B. **Performance**

1. Voltage regulation shall be plus or minus 1.0 percent for any constant load between no load and rated load. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 1.0 percent.
2. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.25%.
3. The diesel engine-generator set shall accept a single step load of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
4. Motor starting capability shall be a minimum of 1210 kVA. The generator set shall be capable of recovering to a minimum of 90% of rated no load voltage following the application of the specified kVA load at near zero power factor applied to the generator set. Maximum voltage dip on application of this load, considering both alternator performance and engine speed changes shall not exceed 25%.
5. The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic, and no 3rd order harmonics or their multiples. Telephone influence factor shall be less than 40.
6. The generator set shall be certified by the engine manufacturer to be suitable for use at the installed location, and shall meet all applicable exhaust emission requirements at the time of commissioning.

C. **Construction**

1. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.
2. All switches, lamps, and meters in the control system shall be oil-tight and dust-tight. All active control components shall be installed within a UL/NEMA 3R enclosure. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.

D. **C**onnections

1. The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical or compression terminations of the number and type as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.
2. Power connections to auxiliary devices shall be made at the devices, with required protection located at a wall-mounted common distribution panel.
3. Generator set control interfaces to other system components shall be made on a permanently labeled terminal block assembly. Labels describing connection point functions shall be provided.

2.02 Engine and Engine Equipment

The engine shall be diesel, 4 cycle, radiator and fan cooled. Minimum displacement shall be 543 cubic inches, with 6 cylinders. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable. Engine accessories and features shall include:

A. An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed. The governing system shall include a programmable warm up at idle and cooldown at idle function. While operating in idle state, the control system shall disable the alternator excitation system.

B. Skid-mounted radiator and cooling system rated for full load operation in 122 degrees F (50 degrees C) ambient as measured at the alternator air inlet. Radiator fan shall be suitable for use in a system with 0.5 in H_2O restriction. Radiator shall be sized based on a core temperature that is 20F higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a controlled environment. Radiator shall be provided with a duct adapter flange. The equipment manufacturer shall fill the cooling system with a 50/50-ethylene glycol/water mixture prior to shipping. Rotating parts shall be guarded against accidental contact.

C. Electric starter(s) capable of three complete cranking cycles without overheating.

D. Positive displacement, mechanical, full pressure, lubrication oil pump.

E. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.

F. An engine driven, mechanical, positive displacement fuel pump. Fuel filter with replaceable spin-on canister element. Fuel cooler, suitable for operation of the generator set at full rated load in the ambient

temperature specified shall be provided if required for operation due to the design of the engine and the installation.

G. Replaceable dry element air cleaner with restriction indicator.

H. Flexible supply and return fuel lines.

I. Engine mounted battery charging alternator, 40-ampere minimum, and solid-state voltage regulator.

J. Coolant heater

1. Engine mounted, thermostatically controlled, coolant heater(s) for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be UL499 listed and labeled.

2. The coolant heater shall be installed on the engine with silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12 inches. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall provisions to isolate the heater for replacement of the heater element without draining the coolant from the generator set. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.

3. The coolant heater shall be provided with a DC thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the coolant heater system.

4. The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 104F (40C) in a 40F (4C) ambient, in compliance with NFPA110 requirements, or the temperature required for starting and load pickup requirements of this specification.

K. Provide vibration isolators, spring/pad type, quantity as recommended by the generator set manufacturer. Isolators shall include seismic restraints if required by site location.

L. Starting and Control Batteries shall be calcium/lead antimony type, 24 volt DC, sized as recommended by the engine manufacturer, complete with battery cables and connectors. The batteries shall be capable of a minimum of three complete 15-second cranking cycles at 40F ambient temperature when fully charged.

M. Provide exhaust silencer(s) for each engine of size and type as recommended by the generator set manufacturer and approved by the engine manufacturer. The mufflers shall be critical grade. Exhaust system shall be installed according to the engine manufacturer’s recommendations and applicable codes and standards.

N. A UL listed certified 12 amp voltage regulated battery charger shall be provided for each engine-generator set. The charger shall be mounted close to the generator set. Input AC voltage and

DC output voltage shall be as required. Chargers shall be equipped with float, taper and equalize charge settings. Operational monitors shall provide visual output along with a form C contact rated at 4 amps, 120 VAC, 30VDC for remote indication of:

Low AC power - red light

Low battery voltage - red light

High battery voltage - red light

High AC voltage – red light

Power ON - green light (no relay contact)

Charger shall include a DC voltmeter and ammeter, 10 hour equalize charge timer, and AC and DC overcurrent protection, and temperature compensation capability.

O. Provide a dual wall sub-base fuel storage tank with 1100 gallons capacity. The tank shall be constructed of corrosion resistant steel and shall be UL listed. The equipment, as installed, shall meet all local and regional requirements for above ground tanks.

2.03 AC Generator

A. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single prelubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system and shall be UL1446 listed. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees Centigrade.

B. The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.

C. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.

D. The subtransient reactance of the alternator shall not exceed 15 percent, based on the standby rating of the generator set.

E. Provide anti-condensation heater for the alternator.

2.04 Generator set Control

The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.

The control shall be mounted on the generator set, or may be mounted in a free-standing panel next to the generator set if adequate space and accessibility is available. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.

Active control circuit boards in the generator set control system shall be fully environmentally protected, either by potting or enclosure of the components in a UL/NEMA 3R enclosure. The entire control system shall be suitable for operation over a range of -20 to +70 centigrade.

The generator set mounted control shall include the following features and functions:

A. Control Switches

1. Mode Select Switch. The mode select switch shall initiate the following control modes. When in MANUAL and the START button pressed, the generator set shall start, and accelerate to rated speed and voltage as directed by the operator. A separate push-button to initiate starting is acceptable. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
2. EMERGENCY STOP switch. Switch shall be Red "mushroom-head" push-button. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.
3. RESET switch. The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
4. PANEL LAMP switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.

B. Generator Set AC Output Metering. The generator set shall be provided with a metering set including the following features and functions:

1. Digital metering set, 1.0% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three-phase voltages (line to neutral or line to line) simultaneously.
2. Analog voltmeter, ammeter, frequency meter, power factor meter, and kilowatt (KW) meter. Voltmeter and ammeter shall display all three phases. Meter scales shall be color coded in the following fashion: green shall indicate normal operating condition, amber shall indicate operation in ranges that indicate potential failure, and red shall indicate failure impending. Metering accuracy shall be within 1.0% at rated output. Both analog and digital metering are required.
3. The control system shall monitor the total load on the generator set, and maintain data logs of total operating hours at specific load levels ranging from 0 to 110% of rated load, in 10% increments. The control shall display hours of operation at less than 30% load and total hours of operation at more than 90% of rated load.
4. The control system shall log total number of operating hours, total kWH, and total control on hours, as well as total values since reset.

C. Engine Condition Metering. The control shall display the following data for the generator set:

1. Control power system DC voltage.

D. Generator Set Data Display. The control system shall display for the following data for the generator set:

1. Generator set model information
2. The control system shall also incorporate a data logging and display provision to allow logging of the last 32 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.

E. Generator Set Alarm and Status Display.

1. The generator set control shall include LED alarm and status indication lamps. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. Functions indicated by the lamps shall include:

    - The control shall include green lamps to indicate that the generator set is running at rated frequency and voltage, and that a remote start signal has been received at the generator set. The running signal shall be based on actual sensed voltage and frequency on the output terminals of the generator set.
    - The control shall include a flashing red lamp to indicate that the control is not in automatic state, and red common shutdown lamp.
    - The control shall include an amber common warning indication lamp.

2. The generator set control shall indicate the existence of the warning and shutdown conditions on the control panel. All conditions indicated below for warning shall be field-configurable for shutdown. Conditions required to be annunciated shall include:

    low oil pressure (warning)
    low oil pressure (shutdown)
    oil pressure sender failure (warning)
    low coolant temperature (warning)
    high coolant temperature (warning)
    high coolant temperature (shutdown)
    high oil temperature (warning)
    engine temperature sender failure (warning)
    low coolant level (warning)
    fail to crank (shutdown)
    fail to start/overcrank (shutdown)
    overspeed (shutdown)
    low DC voltage (warning)
    high DC voltage (warning)
    weak battery (warning)
    low fuel-daytank (warning)
    high AC voltage (shutdown)
    low AC voltage (shutdown)
    under frequency (shutdown)
    over current (warning)
    over current (shutdown)
    short circuit (shutdown)
    ground fault (warning) (optional--when required by code or specified)
    over load (warning)
    emergency stop (shutdown)
    (4) configurable conditions

3. Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above-specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

F. Engine Status Monitoring.

1. The following information shall be available from a digital status panel on the generator set control :

   engine oil pressure (psi or kPA)
   engine coolant temperature (degrees F or C)
   engine oil temperature (degrees F or C)
   engine speed (rpm)
   number of hours of operation (hours)
   number of start attempts
   battery voltage (DC volts)

G. Engine Control Functions.

1. The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.
2. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.
3. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.
4. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
5. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure conditions.

H. Alternator Control Functions:

1. The generator set shall include a full wave rectified automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall

be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase line to line RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate, and be capable of being curve-matched to the engine torque curve with adjustments in the field. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.

2. Microprocessor-based protection device shall be provided to individually monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.

3. Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.

4. Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.

5. A microprocessor-based AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

6. When required by National Electrical Code or indicated on project drawings, the control System shall include a ground fault monitoring relay. The relay shall be adjustable from 3.8-1200 amps, and include adjustable time delay of 0-10.0 seconds. The relay shall be for indication only and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set, and provide relay that will function correctly in system as installed.

7. The generator set control shall include a 120VAC-control heater.

I. Other Control Functions

1. The generator set shall be provided with an RS-485 network communication module to allow efficient communication with the generator set control by remote devices. The control shall communicate all engine and alternator data, and allow starting and stopping of the generator set via the network. Provide external modules for the following functions, as required to meet application needs:
    - Remote Annunciator
2. The generator set shall include an RS-485 interface to allow remote monitoring of the control via Modbus RTU protocol as shown per the drawings.
3. A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 25VDC or more than 32 VDC. During engine cranking (starter engaged), the low voltage limit shall be disabled, and DC voltage shall be monitored as load is applied to the battery, to detect impending battery failure or deteriorated battery condition.

J. Control Interfaces for Remote Monitoring:

1. The control system shall provide four programmable output relays. These relay outputs shall be configurable for any alarm, shutdown, or status condition monitored by the control. The relays shall be configured to indicate: (1) generator set operating at rated voltage and frequency, (2) common warning, (3) common shutdown, (4) load shed command.
2. A fused 10 amp switched 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.
3. A fused 10 amp 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.
4. For generator sets mounted out of doors, provide a duplicate operator control panel for the generator set, mounted at a monitored location inside the facility. The operator panel shall interconnect to the generator set over an RS485 network. Control power for the operator panel shall be derived from the generator set DC control power system.

2.05 Other equipment to be provided with the generator set

A. Provide and install a 20-light LED type remote alarm annunciator with horn, located as shown on the drawings or in a location that can be conveniently monitored by facility personnel. The remote annunciator shall provide all the audible and visual alarms called for by NFPA Standard 110 for level 1 systems for the local generator control panel. Spare lamps shall be provided to allow future addition of other alarm and status functions to the annunciator. Provisions for labeling of the annunciator in a

fashion consistent with the specified functions shall be provided. Alarm silence and lamp test switch(es) shall be provided. LED lamps shall be replaceable, and indicating lamp color shall be capable of changes needed for specific application requirements. Alarm horn shall be switchable for all annunciation points. Alarm horn (when switched on) shall sound for first fault, and all subsequent faults, regardless of whether first fault has been cleared, in compliance with NFPA110 3-5.6.2. The interconnecting wiring between the annunciator and other system components shall be monitored and failure of the interconnection between components shall be displayed on the annunciator panel.

B. The annunciator shall include the following alarm labels, audible annunciation features, and lamp colors:

Condition	Lamp Color	Audible Alarm
Normal Power (to Loads)	Green	No
Genset Supplying Load	Amber	No
Genset Running	Green	No
Not in Auto	Red (Flashing)	Yes
High Battery Voltage	Red	Yes
Low Battery Voltage	Red	Yes
Charger AC Failure	Red	Yes
Low Cranking Voltage	Amber	Yes
Fail to Start	Red	Yes
Low Engine Temperature	Amber	Yes
Pre-High Engine Temperature	Amber	Yes
High Engine Temperature	Red	Yes
Pre-Low Oil Pressure	Amber	Yes
Low Oil Pressure	Red	Yes
Overspeed	Red	Yes
Low Coolant Level	Amber	Yes
Low Fuel Level	Amber	Yes
Network OK	Green	Yes
(4) Spares	Configurable	Configurable

C. The generator set shall be provided with a mounted main line circuit breaker, sized to carry the rated output current of the generator set. The circuit breaker shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions, or a thermal-magnetic trip with other overcurrent protection devices that positively protect the alternator under overcurrent conditions. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided.

D. Outdoor Weather-Protective Enclosure

1. The generator set shall be provided with an outdoor enclosure, with the entire package listed under UL2200. The package shall comply with the requirements of the National Electrical Code for all wiring materials and component spacing. Generator set housing shall be provided factory-assembled to generator set base and radiator cowling. Housing shall provide ample airflow for generator set operation at rated load in an ambient temperature of 100F. The housing shall have hinged side-access doors and rear control door as required to maintain easy access for all service functions. All doors shall be lockable, and include retainers to hold the door open during service. Enclosure roof shall be cambered to prevent rain water accumulation. Openings shall be screened to limit access of rodents into the enclosure. All electrical power and control interconnections shall be made within the perimeter of the enclosure. The enclosure shall include provisions to allow for lifting with spreader bars.
2. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturers standard color using a two step electrocoating paint process, or equal meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating that meets the following requirements:

    Primer thickness, 0.5-2.0 mils. Top coat thickness, 0.8-1.2 mils.

    Gloss, per ASTM D523-89, 80% plus or minus 5%. Gloss retention after one year shall exceed 50%.

    Crosshatch adhesion, per ASTM D3359-93, 4B-5B.

    Impact resistance, per ASTM D2794-93, 120-160 inch-pounds.

    Salt Spray, per ASTM B117-90, 1000+ hours.

    Humidity, per ASTM D2247-92, 1000+ hours.

    Water Soak, per ASTM D2247-92, 1000+ hours.

3. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.
4. Enclosure shall be constructed of minimum 12 gauge steel for framework and 14 gauge steel for panels. All hardware and hinges shall be stainless steel.
5. A factory-mounted exhaust silencer shall be installed inside the enclosure. The exhaust shall exit the enclosure through a rain collar and terminate with a rain cap. Exhaust connections to the generator set shall be through seamless flexible connections.
6. The enclosure shall include the following maintenance provisions:
    - Flexible coolant and lubricating oil drain lines, that extend to the exterior of the enclosure, with internal drain valves
    - External radiator fill provision.
7. Provide an external emergency stop switch that is protected from accidental actuation.
8. Provide motorized louvers to minimize air flow through the enclosure when generator set is not operating. Louvers shall include provisions to prevent accumulation of ice or snow that might prevent operation.
9. Inlet ducts shall include rain hoods.
10. Provide a factory mounted and wired electrical distribution panel to serve the generator set and enclosure. The provisions required include:
    - 100-amp distribution panelboard connected to a 120/240VAC 208 WYE utility service by the installer.
    - Two duplex GFI receptacles.
    - Two three-way switches controlling three AC lamps mounted in vapor tight and gasketed fixtures.
    - Factory-wired normal AC service from the panelboard to the engine coolant and alternator heaters, and battery charger.

11. The generator set shall be provided with a sound-attenuated housing which allows the generator set to operate at full rated load in an ambient temperature of up to 100F. The enclosure shall reduce the sound level of the generator set while operating at full rated load to a maximum of 71 dBA at any location 7 meters from the generator set in a free field environment.
12. The enclosure shall be insulated with non-hygroscopic materials.

E. Provide a sub-base fuel tank for the generator set, sized to allow for full load operation of the generator set for 48 hours. The sub-base fuel tank shall be UL142 listed and labeled. Installation shall be in compliance to NFPA37. The fuel tank shall be a double-walled, steel construction and include the following features:

1. Emergency tank and basin vents.
2. Mechanical level gauge.
3. Fuel supply and return lines, connected to generator set with flexible fuel lines as recommended by the engine manufacturer and in compliance to UL2200 and NFPA 37 requirements.
4. Leak detection provisions, wired to the generator set control for local and remote alarm indication.
5. High and low level float switches to indicate fuel level. Wire switches to generator control for local and remote indication of fuel level
6. Basin drain.
7. Integral lifting provisions.

Part 3. OPERATION

3.01 Sequence of Operation

A. Generator set shall start on receipt of a start signal from remote equipment. The start signal shall be via hardwired connection to the generator set control and a redundant signal over the required network connection.

B. The generator set shall complete a time delay start period as programmed into the control.

C. The generator set control shall initiate the starting sequence for the generator set. The starting sequence shall include the following functions:

D. The control system shall verify that the engine is rotating when the starter is signaled to operate. If the engine does not rotate after two attempts, the control system shall shut down and lock out the generator set, and indicate “fail to crank” shutdown.

E. The engine shall fire and accelerate as quickly as practical to start disconnect speed. If the engine does not start, it shall complete a cycle cranking process as described elsewhere in this specification. If the engine has not started by the completion of the cycle cranking sequence, it shall be shut down and locked out, and the control system shall indicate “fail to start”.

F. The engine shall accelerate to rated speed and the alternator to rated voltage. Excitation shall be disabled until the engine has exceeded programmed idle speed, and regulated to prevent over voltage conditions and oscillation as the engine accelerates and the alternator builds to rated voltage.

G. On reaching rated speed and voltage, the generator set shall operate as dictated by the control system in isochronous state.

H. When all start signals have been removed from the generator set, it shall complete a time delay stop sequence. The duration of the time delay stop period shall be adjustable by the operator.

I. On completion of the time delay stop period, the generator set control shall switch off the excitation system and shall shut down.

J. Any start signal received after the time stop sequence has begun shall immediately terminate the stopping sequence and return the generator set to isochronous operation.

Part 4. OTHER REQUIREMENTS

4.01 Submittals

A. Within 10 days after award of contract, provide six sets of the following information for review:

- Manufacturer’s product literature and performance data, sufficient to verify compliance to specification requirements.
- A paragraph by paragraph specification compliance statement, describing the differences between the specified and the proposed equipment.
- Manufacturer's certification of prototype testing.
- Manufacturer's published warranty documents.
- Shop drawings showing plan and elevation views with certified overall dimensions, as well as wiring interconnection details.
- Interconnection wiring diagrams showing all external connections required; with field wiring terminals marked in a consistent point-to-point manner.
- Manufacturer's installation instructions.

4.02 Factory Testing

A. The generator set manufacturer shall perform a complete operational test on the generator set prior to shipping from the factory. A certified test report shall be provided. Equipment supplied shall be fully tested at the factory for function and performance.

B. Factory testing may be witnessed by the owner and consulting engineer. Costs for travel expenses will be the responsibility of the owner and consulting engineer. Supplier is responsible to provide two weeks notice for testing.

C. Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include: run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup, and function of safety shutdowns.

4.03 Installation

A. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

B. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

C. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer’s instructions and seismic requirements of the site.

D. Equipment shall be initially started and operated by representatives of the manufacturer.

E. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

4.04 On-Site Acceptance Test:

A. The complete installation shall be tested for compliance with the specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests.

B. Installation acceptance tests to be conducted on-site shall include a "cold start" test, a two hour full load test, and a one step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.

C. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

4.05 Training

A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner.

4.06 Service and support

A. The manufacturer of the generator set shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.

B. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

C. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

4.07 Warranty

A. The generator set and associated equipment shall be warranted for a period of not less than 5 years from the date of commissioning against defects in materials and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

END OF SECTION 263213

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches.
2. Bypass/isolation switches.
3. Remote annunciation systems.
4. Remote annunciation and control systems.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Qualification Data: For manufacturer.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Features and operating sequences, both automatic and manual.
2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Source Limitations: Obtain automatic transfer switches, bypass/isolation switches remote annunciator and control panels through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NEMA ICS 1.

E. Comply with NFPA 70.

F. Comply with NFPA 99.

G. Comply with NFPA 110.

H. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:

1. Notify Architect and Owner no fewer than two days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Architect's and Owner's written permission.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements when specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Asco.
2. Russ electric.

3. Cummins.

Other manufacturers equal in design will be considered up A/E approval following substitution procedure in Division o1 for substitution requirement.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including all loads and ampere rating, without derating.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

G. Neutral Switching. Where four-pole switches are indicated, provide overlapping neutral contacts. The fourth (neutral) pole shall be identele to phase poles. Add-on neutral contacts are not acceptable.

H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

I. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.

J. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.

K. Battery Charger: For generator starting batteries.

1. Float type rated.
2. Ammeter to display charging current.

3. Fused ac inputs and dc outputs.

L. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

M. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

N. Enclosures: General-purpose NEMA 250, Type 1 or 3R as shown on drawigns, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

D. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

E. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

F. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

G. Automatic Closed-Transition Transfer Switches: Include the following functions and characteristics:

1. Fully automatic make-before-break operation.
2. Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms.
3. Initiation of No-Interruption Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable.

    a. Initiation occurs without active control of generator.
    b. Controls ensure that closed-transition load transfer closure occurs only when the 2 sources are within plus or minus 5 electrical degrees maximum, and plus or minus 5 percent maximum voltage difference.

4. Failure of power source serving load initiates automatic break-before-make transfer.

H. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

I. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Pause is adjustable from 0.5 to 30 seconds minimum and factory set for 0.5 second, unless otherwise indicated. Time delay occurs for both transfer directions. Pause is disabled unless both sources are live.

J. Automatic Transfer-Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
    a. Where shown on the drawings, transfer switches applied as service entrance switches shall be provided with overcurrent trip units and a service entrance label. An external key-operated selector switch shall be provided to disconnect the power supplies. Indicators shall be provided to show the availability of each source as well as breakers in a tripped or disconnected position. Provide a neutral disconnect link for three-pole solid neutral switches, and a neutral-to ground main bonding jumper for all switches to meet UL service entrance requirement s Ground Fault protection shall be provided for all switches rated 1000 amperes or more in accordance with NEC Article 230.95.

2.4 BYPASS/ISOLATION SWITCHES

A. Comply with requirements for Level 1 equipment according to NFPA 110.

B. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:

1. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. While isolated, interlocks prevent transfer-switch operation, except for testing or maintenance.
2. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations.
3. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.
4. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
5. Operability: Constructed so load bypass and transfer-switch isolation can be performed by 1 person in no more than 2 operations in 15 seconds or less.
6. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
7. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.

C. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

2.5 NONAUTOMATIC TRANSFER SWITCHES

A. Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternate Source." Switch shall be capable of transferring load in either direction with either or both sources energized.

B. Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternate Source." In addition, removable manual handle provides quick-make, quick-break manual-switching action. Switch shall be capable of electrically or manually transferring load in either direction with either or both sources energized. Control circuit disconnects from electrical operator during manual operation.

C. Double-Throw Switching Arrangement: Incapable of pauses or intermediate position stops during switching sequence.

D. Nonautomatic Transfer-Switch Accessories:

1. Pilot Lights: Indicate source to which load is connected.
2. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and alternate-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Alternate Source Available."

3. Unassigned Auxiliary Contacts: One set of normally closed contacts for each switch position, rated 10 A at 240-V ac.

2.6 REMOTE ANNUNCIATOR SYSTEM

A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:

1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
2. Switch position.
3. Switch in test mode.
4. Failure of communication link.

B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.

1. Indicating Lights: Grouped for each transfer switch monitored.
2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
3. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.
4. Lamp Test: Push-to-test or lamp-test switch on front panel.

2.7 REMOTE ANNUNCIATOR AND CONTROL SYSTEM

A. Functional Description: Include the following functions for indicated transfer switches:

1. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
2. Indication of switch position.
3. Indication of switch in test mode.
4. Indication of failure of digital communication link.
5. Key-switch or user-code access to control functions of panel.

6. Control of switch-test initiation.
7. Control of switch operation in either direction.
8. Control of time-delay bypass for transfer to normal source.

B. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically reverts to stand-alone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.

C. Remote Annunciation and Control Panel: Solid-state components. Include the following features:

1. Controls and indicating lights grouped together for each transfer switch.
2. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.
3. Digital Communication Capability: Matched to that of transfer switches supervised.
4. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.

D. The controller shall be equipped with self diagnostics, which performs periodic checks of the memory, input/output (I/O), and communication circuits, with a watchdog/power fail circuit.

E. The controller shall be accurate to within 1 percent of full-scale value for measured parameter. Voltage and current for all phases shall be sampled simultaneously to assure high accuracy in conditions of low power factor or large wave form distortions.

F. A digital readout shall display each option as it is functioning. Readouts shall display:
1. Three phase voltage with 1 percent accuracy to display all three separate phase-to-phase voltage simultaneously, for both the normal and emergency source.
2. Frequency with 1 percent accuracy to display frequency for both normal and emergency source.
3. Availability of normal source and emergency source.

G. The following metered readings shall also be communicated by the Controller, via local display and serial communication.
1. Current, per phase RMS and neutral
2. Current unbalance %
3. Voltage, phase-to-phase and phase-to-neutral
4. Voltage unbalance %
5. Real power (KW) per phase and 3-phase total
6. Apparent power (KVA), per phase and 3-phase total
7. Reactive power (KVAR), per phase and 3-phase total
8. Power factor, per phase and 3-phase total
9. Peak KVA demand (resettable)
10. Accumulated energy KWH

2.8 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Floor-Mounting Switch: Anchor to floor by bolting.

1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."

C. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

D. Identify components according to Division 26 Section "Identification for Electrical Systems."

E. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages

and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

a. Check for electrical continuity of circuits and for short circuits.
b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
c. Verify that manual transfer warnings are properly placed.
d. Perform manual transfer operation.

4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
b. Simulate loss of phase-to-ground voltage for each phase of normal source.
c. Verify time-delay settings.
d. Verify pickup and dropout voltages by data readout or inspection of control settings.
e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

a. Verify grounding connections and locations and ratings of sensors.

C. Tests and Inspections:

1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
2. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

a. Check for electrical continuity of circuits and for short circuits.
b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
c. Verify that manual transfer warnings are properly placed.
d. Perform manual transfer operation.

3. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
b. Simulate loss of phase-to-ground voltage for each phase of normal source.
c. Verify time-delay settings.

d. Verify pickup and dropout voltages by data readout or inspection of control settings.
e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

4. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

a. Verify grounding connections and locations and ratings of sensors.

D. Coordinate tests with tests of generator and run them concurrently.

E. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

F. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Demonstration and Training."

B. Coordinate th is training with that for generator equipment.

END OF SECTION 263600

SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes lightning protection for **structures**.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For air terminals and mounting accessories.

1. Layout of the lightning protection system, along with details of the components to be used in the installation.
2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and manufacturer. Include data on listing or certification by UL.

B. Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.

C. Field quality-control reports.

D. Comply with recommendations in NFPA 780, Annex D, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the lightning protection system.

E. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:

1. Ground rods.
2. Ground loop conductor.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Certified by **LPI as a Master Installer/Designer**, trained and approved for installation of units required for this Project.

B. System Certificate:

1. UL Master Label.
2. LPI System Certificate.
3. UL Master Label Recertification.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

1.6 COORDINATION

A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.

C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Comply with UL 96 **and NFPA 780**.

B. Roof-Mounted Air Terminals: NFPA 780, **Class I/Class II copper** unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following:**

a. East Coast Lightning Equipment Inc.
b. ERICO International Corporation.
c. Harger.
d. Heary Bros. Lightning Protection Co. Inc.
e. Independent Protection Co.
f. Preferred Lightning Protection.
g. Robbins Lightning, Inc.
h. Thompson Lightning Protection, Inc.

2. Air Terminals More than 24 Inches (600 mm) Long: With brace attached to the terminal at not less than half the height of the terminal.
3. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in Division 07 roofing Sections.

C. Main and Bonding Conductors: **Copper**

D. Ground Loop Conductor: The same size and type as the main conductor except tinned.

E. Ground Rods: LINCOLN XIT GROUNDING SYSTEM

F. Heavy-Duty, Stack-Mounted, Lightning Protection Components: **Solid copper**

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lightning protection components and systems according to **UL 96A and NFPA 780**.

B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends.

C. Conceal the following conductors:

1. System conductors.
2. Down conductors.
3. Interior conductors.
4. Conductors within normal view of exterior locations at grade within 200 feet (60 m) of building.

D. Cable Connections: Use crimped or bolted connections for all conductor splices and connections between conductors and other components. Use exothermic-welded connections in underground portions of the system.

E. Cable Connections: Use exothermic-welded connections for all conductor splices and connections between conductors and other components.

1. Exception: In single-ply membrane roofing, exothermic-welded connections may be used only below the roof level.

F. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.

G. Bond extremities of vertical metal bodies exceeding 60 feet (18 m) in length to lightning protection components.

H. Ground Loop: Install ground-level, potential equalization conductor and extend around the perimeter of **structure.**

1. Bury ground ring not less than **24 inches (600 mm)**] from building foundation.
2. Bond ground terminals to the ground loop.
3. Bond grounded building systems to the ground loop conductor within 12 feet (3.6 m) of grade level.

I. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot (18-m) intervals.

3.2 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.3 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.

B. UL Inspection: Meet requirements to obtain a UL Master Label for system.

C. LPI System Inspection: Meet requirements to obtain an LPI System Certificate.

END OF SECTION 264113

SECTION 26 43 13 - TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes field-mounted TVSS (Surge Protective Device-SPD) for low-voltage (120 to 600 V) power distribution and control equipment.

B. Related Sections:

1. Division 26 Section "Switchboards" for factory-installed TVSS.
2. Division 26 Section "Panelboards" for factory-installed TVSS.

1.3 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. VPR: Voltage Protection Rating

C. TVSS: TVSS (Surge Protective Device-SPD) Transient voltage surge suppressor(s), both singular and plural; also, transient voltage surge suppression.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.

B. Qualification Data: For qualified testing agency.

C. Product Certificates: For TVSS devices, from manufacturer.

D. Field quality-control reports.

E. Operation and Maintenance Data: For TVSS devices to include in emergency, operation, and maintenance manuals.

F. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.

C. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.

D. Comply with NEMA LS 1.

E. Comply with UL 1283 and UL 1449.

F. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed electrical service interruptions.
2. Do not proceed with interruption of electrical service without Owner's written permission.

B. Service Conditions: Rate TVSS devices for continuous operation under the following conditions unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: 30 to 120 deg F (0 to 50 deg C).
3. Humidity: 0 to 85 percent, noncondensing.
4. Altitude: Less than 20,000 feet (6090 m) above sea level.

1.7 COORDINATION

A. Coordinate location of field-mounted TVSS devices to allow adequate clearances for maintenance.

B. Coordinate TVSS devices with Division 26 Section "Electrical Power Monitoring and Control."

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship or any end of life electrical even within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE SUPPRESSORS (TYPE A)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings product by one of the following:
1. Current Technology Inc.; Danaher Power Solutions.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.
5. General Electric

C. Surge Protection Devices:

1. Modular.
2. LED indicator lights for power and protection status.
3. Audible alarm, with silencing switch, to indicate when protection has failed.
4. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

D. Surge Protection Devices:

1. Comply with UL 1449 Latest Edition.
2. Modular design (with field-replaceable modules) Non-modular design.
3. Fuses, rated at 200-kA interrupting capacity.
4. Fabrication using bolted compression lugs for internal wiring.
5. Integral disconnect switch or circuit breakers in panel.
6. Redundant suppression circuits.
7. Redundant replaceable modules.
8. Arrangement with copper bus bars and for bolted connections to phase buses, neutral bus, and ground bus.
9. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
10. LED indicator lights for power and protection status.
11. Audible alarm, with silencing switch, to indicate when protection has failed.
12. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
13. Four -digit transient-event counter set to totalize transient surges.

E. Peak Single-Impulse Surge Current Rating: 240 kA per mode/3000 kA per phase.

F. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2

1. Line to Neutral: 70,000 A.
2. Line to Ground: 70,000 A.
3. Neutral to Ground: 50,000 A.

G. Protection modes and and UL 1449 Third Edition Clamp voltage for grounded wye circuits with 480Y/277 , 3-phase, 4-wire circuits shall be as follows (SERVICE ENTRANCE SUPPRESSORS (Type 1):

1. Line to Neutral: 1200V for 480Y/277 V.
2. Line to Ground: 1200 V for 480Y/277 V.
3. Neutral to Ground: 800 V for 480Y/277 V.
4. Line to Line: 1600 V for 480Y/277 V.

H. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Current Technology

I. Surge Protection Devices:

1. Comply with UL 1449.
2. Modular design (with field-replaceable modules)
3. Short-circuit current rating complying with UL 1449, and matching or exceeding the panelboard short-circuit rating and redundant suppression circuits; with individually fused metal-oxide varistors.
4. Fuses, rated at 200-kA interrupting capacity.
5. Fabrication using bolted compression lugs for internal wiring.
6. Integral disconnect switch.
7. Redundant suppression circuits.
8. Redundant replaceable modules.
9. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
10. LED indicator lights for power and protection status.
11. Audible alarm, with silencing switch, to indicate when protection has failed.
12. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
13. Four digit transient-event counter set to totalize transient surges.

J. Peak Single-Impulse Surge Current Rating: Type B 160 kA per mode/320 kA per Phase Type C 80 kA per mode/160 kA per phase.

K. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2:

1. Line to Neutral: 70,000 A.
2. Line to Ground: 70,000 A.
3. Neutral to Ground: 50,000 A.

L. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, 3-phase, 4-wire circuits shall be as follows:

1. Line to Neutral: 400 V for 208Y/120 V.

2. Line to Ground: 400 V for 208Y/120 V].
3. Neutral to Ground: 400 V for 208Y/120 V.

M. Protection modes and UL 1449 VPR for 240/120-V, single-phase, 3-wire circuits shall be as follows (PANELBOARD SUPPRESSORS (Type 2, 3) :

1. Line to Neutral: 400 V.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.
4. Line to Line: 800 V

N. Protection modes and UL 1449 VPR for 240 V, 480 V, or 600 V, 3-phase, 3-wire, delta circuits shall be as follows (PANELBOARD SUPPRESSORS (Type 2, 3):

1. Line to Line: 1600 V for 480 V.
2. Line to Ground: 800 V for 480 V.

2.2 ENCLOSURES

A. Indoor Enclosures: NEMA 250 Type 1.

B. Outdoor Enclosures: NEMA 250 Type 3R or Type 4.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install TVSS devices at service entrance on load side, with ground lead bonded to service entrance ground.

B. Install TVSS devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

1. Provide multiple, 30, 60 or 100 -A circuit breaker as a dedicated disconnecting means for TVSS unless otherwise indicated.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

1. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
2. After installing TVSS devices but before electrical circuitry has been energized, test for compliance with requirements.
3. Complete startup checks according to manufacturer's written instructions.

D. TVSS device will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Do not energize or connect service entrance equipment , or panelboards to their sources until TVSS devices are installed and connected.

B. Do not perform insulation resistance tests of the distribution wiring equipment with the TVSS installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to maintain TVSS devices.

END OF SECTION 264313

SECTION 26 51 00
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.
5. Retrofit kits for fluorescent lighting fixtures.

B. Related Sections:
1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Division 26 Section "Network Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.
3. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CCT: Correlated color temperature.

C. CRI: Color-rendering index.

D. HID: High-intensity discharge.

E. LER: Luminaire efficacy rating.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.

3. Ballast, including BF.
4. Energy-efficiency data.
5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
    a. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Installation instructions.

D. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Lighting fixtures.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extends to within 12 inches (305 mm) of the plane of the luminaires.
4. Ceiling-mounted projectors.
5. Structural members to which suspension systems for lighting fixtures will be attached.
6. Other items in finished ceiling including the following:
    a. Air outlets and inlets.
    b. Speakers.
    c. Sprinklers.
    d. Smoke and fire detectors.
    e. Occupancy sensors.
    f. Access panels.
7. Perimeter moldings.

E. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

F. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

G. Field quality-control reports.

H. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

I. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

D. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
   2. Warranty Period for Emergency Fluorescent Ballast [and] [Self-Powered Exit Sign] Batteries: [Seven] <Insert number> years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.
   3.

B. Special warranty for Ballots: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for electronic Ballasts: Five years from date of substantial completion.
   2. Warranty Period for Electromagnetic Ballasts: Three years from date of substantial completion.

C. Special warranty for T5 and T8 florescent lamps: Manufacturer's standard form, made out to Owner and signed by Lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to project site, within specified warranty period indicated below.
   1. Warranty Period: One year from date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Interior Lighting fixture schedule where titles below are column or row headings that indicate lists, the following requirements apply to product selection:

B.

1. Basis-of-Design Product: The design for each lighting fixture is based on the product named. Subject to compliance with requirements, provide either the named product or approved equal. Equal products shall be submitted to engineer for approval 10 days prior to bid in binder format with any deviations of specified items noted. Only items approved through addendum shall be acceptable.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

C. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

D. Metal Parts: Free of burrs and sharp corners and edges.

E. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

G. Diffusers and Globes:
   1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
      a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
      b. UV stabilized.
   2. Glass: Annealed crystal glass unless otherwise indicated.

H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
   1. Label shall include the following lamp and ballast characteristics:
      a. "USE ONLY" and include specific lamp type.
      b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
      c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
      d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
      e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
      f. CCT and CRI for all luminaires.

I. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

J. Air-Handling Fluorescent Fixtures: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser-boot assembly specified in Division 23 Section "Diffusers, Registers, and Grilles."
   1. Air-Supply Units: Slots in one or both side trims join with air-diffuser-boot assemblies.
   2. Heat-Removal Units: Air path leads through lamp cavity.
   3. Combination Heat-Removal and Air-Supply Unit: Heat is removed through lamp cavity at both ends of the fixture door with air supply same as for air-supply units.
   4. Dampers: Operable from outside fixture for control of return-air volume.
   5. Static Fixture: Air-supply slots are blanked off, and fixture appearance matches active units.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. General Requirements for Electronic Ballasts:
   1. Comply with UL 935 and with ANSI C82.11.
   2. Designed for type and quantity of lamps served.
   3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
   4. Sound Rating: Class A.
   5. Total Harmonic Distortion Rating: Less than 10 percent.
   6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
   7. Operating Frequency: 20 kHz or higher.
   8. Lamp Current Crest Factor: 1.7 or less.
   9. BF: 0.88 or higher.
   10. Power Factor: 0.98 or higher.
   11. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

B. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.
   1. Ballast Manufacturer Certification: Indicated by label.

C. Single Ballasts for Multiple Lighting Fixtures: Factory wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

D. Ballasts for Low-Temperature Environments:
   1. Temperatures 0 Deg F (Minus 17 Deg C) and Higher: Electronic or electromagnetic type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.
   2. Temperatures Minus 20 Deg F (Minus 29 Deg C) and Higher: Electromagnetic type designed for use with indicated lamp types.

E. Ballasts for Low Electromagnetic-Interference Environments: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.

F. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
   1. Dimming Range: 100 to 5 percent of rated lamp lumens.
   2. Ballast Input Watts: Can be reduced to 20 percent of normal.
   3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
   4. Control: Coordinate wiring from ballast to control device to ensure that the ballast, controller, and connecting wiring are compatible.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
   1. Lamp end-of-life detection and shutdown circuit.
   2. Automatic lamp starting after lamp replacement.
   3. Sound Rating: Class A.
   4. Total Harmonic Distortion Rating: Less than 20 percent.
   5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
   6. Operating Frequency: 20 kHz or higher.
   7. Lamp Current Crest Factor: 1.7 or less.
   8. BF: 0.95 or higher unless otherwise indicated.
   9. Power Factor: 0.98or higher.
   10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

2.5 EMERGENCY POWER UNIT

A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.
   1. Emergency Connection: Operate one lamp(s) continuously at an output of 1400 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
   2. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
      a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
      b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
   3. Battery: Sealed, maintenance-free, nickel-cadmium type.
   4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
   5. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
   6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.6 BALLASTS FOR HID LAMPS

A. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features unless otherwise indicated:
   1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
   2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C) for single-lamp ballasts.
   3. Rated Ambient Operating Temperature: 104 deg F (40 deg C).
   4. Open-circuit operation that will not reduce average life.
   5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.

B. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:
   1. Minimum Starting Temperature: Minus 20 deg F (Minus 29 deg C) for single-lamp ballasts.
   2. Rated Ambient Operating Temperature: 130 deg F (54 deg C).

3. Lamp end-of-life detection and shutdown circuit.
4. Sound Rating: Class A.
5. Total Harmonic Distortion Rating: Less than 15 percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Lamp Current Crest Factor: 1.5 or less.
8. Power Factor: 0.90 or higher.
9. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
10. Protection: Class P thermal cutout.

2.7 QUARTZ LAMP LIGHTING CONTROLLER

A. General Requirements for Controllers: Factory installed by lighting fixture manufacturer. Comply with UL 1598.

B. Standby (Quartz Restrike): Automatically switches quartz lamp on when a HID lamp in the fixture is initially energized and during the HID lamp restrike period after brief power outages.

C. Connections: Designed for a single branch -circuit connection.

D. Switching Off: Automatically switches quartz lamp off when HID lamp strikes.

E. Switching Off: Automatically switches quartz lamp off when HID lamp reaches approximately 60 percent light output.

2.8 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
   1. Lamps for AC Operation: Fluorescent, two for each fixture, 20,000 hours of rated lamp life.
   2. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
   3. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
      a. Battery: Sealed, maintenance-free, nickel-cadmium type.
      b. Charger: Fully automatic, solid-state type with sealed transfer relay.
      c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
      d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
      e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
      f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
      g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.9 EMERGENCY LIGHTING UNITS

A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
   1. Battery: Sealed, maintenance-free, lead-acid type.
   2. Charger: Fully automatic, solid-state type with sealed transfer relay.
   3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
   4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
   6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
   7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
   8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
   9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.10 FLUORESCENT LAMPS

A. T8 rapid-start lamps, rated 32 W maximum, nominal length of 48 inches (1220 mm), 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 4100 K, and average rated life 20,000 hours unless otherwise indicated.

B. T8 rapid-start lamps, rated 17 W maximum, nominal length of 24 inches (610 mm), 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 4100 K, and average rated life of 20,000 hours unless otherwise indicated.

C. T5 rapid-start lamps, rated 28 W maximum, nominal length of 45.2 inches (1150 mm), 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours unless otherwise indicated.

D. T5HO rapid-start, high-output lamps, rated 54 W maximum, nominal length of 45.2 inches (1150 mm), 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours unless otherwise indicated.

E. Compact Fluorescent Lamps: 4-Pin, CRI 80 (minimum), color temperature 3500 K, average rated life of 10,000 hours at three hours operation per start, and suitable for use with dimming ballasts unless otherwise indicated.
   1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
   2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
   3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
   4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
   5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
   6. 57 W: T4, triple tube, rated 4300 initial lumens (minimum).
   7. 70 W: T4, triple tube, rated 5200 initial lumens (minimum).

2.11 HID LAMPS

A. Metal-Halide Lamps: ANSI C78.43, with minimum CRI 65, and color temperature 4000 K.

B. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000K.

C. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4000 K.

2.12 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm).

F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.13 LED LIGHT FIXTURES AND LED LAMPS

1. All LED products must be UL, ETL and/or CSA listed

2. All LED products must have LM-79 and LM-80 testing noted on specification sheet by an independent test lab.

3. All LED products should be identified as L70 and/or L90 ratings based on independent test lab data.

4. All LED products must be serviceable for accessible for field repair needs.

5. All indoor lighting color rendering should be within one standard deviation to McAdams 3-step ellipse.

6. All control systems that interface with an LED product will be supported by a project “integrator” until project completion. This includes contact with the installer prior to installation, availability during installation, and final checkout and startup after installation.

    a. Reporting of final startup completion of the controls system back to the engineer is mandatory.

b. Invitation to attend the training with the owner's representative should be made to the engineer no less than 5 days prior to training

c. Signature confirmation of training and startup is required within 5 business days after completion back to the engineer's office.

1. A follow up call will be made to the owner 30-45 days after the startup and training of the controls system by the manufacturer's representative to ensure all systems are operating to design specification. A 3 hour onsite system fine tuning at no additional cost to the owner is inclusive.

10. All LED drivers should be capable of 0-10 volt controls and shall dim to 1% of total lumen output. Where specifically specified the dimming driver may be required to dim to .1% of lumen output, otherwise known as "dim to dark".

11. Driver manufacturers must have a 5 year history producing dimmable electronic LED drivers for the North American market.

12. Ambient driver temperatures must be within -4 to 122 degrees Fahrenheit.

13. Driver must limit inrush current and the following specifications:

a. Base specification: meet or exceed NEMA 410 driver inrush standard of 430 amp per 10 amps load with a maximum of 370 amps/2 seconds
b. Preferred specification: Meet or exceed 30ma's at 277 VAC for up to 50 watts of load and 75A at 240 microseconds at 277 VAC for 100 watts of load.
c. Withstand up to a 1,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A.
d. No visible change in light output with a variation of plus/minus 10percent line voltage input.
e. Total harmonic distortion less than 20%, and meet ANSI C82.11 maximum allowable THD requirements at full output. THD shall at no point in the dimming curve allow imbalance current to exceed full output THD.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:
1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When

construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
1. Install ceiling support system rods or wires for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

E. Suspended Lighting Fixture Support:
1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.

G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Verify that self-luminous exit signs are installed according to their listing and the requirements in NFPA 101.

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.4 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

END OF SECTION 26 51 00

SECTION 265600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior luminaires with lamps and ballasts.
2. Poles and accessories.

B. Related Sections:

1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. HID: High-intensity discharge.

D. LER: Luminaire efficacy rating.

E. Luminaire: Complete lighting fixture, including ballast housing if provided.

F. Pole: Luminaire support structure, including tower used for large area illumination.

G. Standard: Same definition as "Pole" above.

1.4 SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.

a. Testing Agency Certified Data: For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
b. Manufacturer Certified Data: Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

6. Ballasts, including energy-efficiency data.
7. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.
8. Materials, dimensions, and finishes of poles.
9. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
10. Anchor bolts for poles.

B. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

C. Field quality-control reports.

D. Operation and Maintenance Data: For luminaires to include in emergency, operation, and maintenance manuals.

E. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with IEEE C2, "National Electrical Safety Code."

D. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
4. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. An exterior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

1. Equal products shall be submitted to engineer for approval 10 days prior to bid in binder format, with any deviations from specified items noted. Only items approved through addendum shall be acceptable.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

M. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

    a. Color: As selected from manufacturer's standard catalog of colors.

N. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

    a. "USES ONLY" and include specific lamp type.
    b. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
    c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
    d. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.
    e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
    f. CCT and CRI for all luminaires.

2.3 FLUORESCENT BALLASTS AND LAMPS

A. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F and Higher: Electronic or electromagnetic type rated for 0 deg F starting and operating temperature with indicated lamp types.
2. Temperatures Minus 20 Deg F and Higher: Electromagnetic type designed for use with indicated lamp types.

B. Ballast Characteristics:

1. Power Factor: 98 percent, minimum.
2. Sound Rating: Class A.
3. Total Harmonic Distortion Rating: Less than 10 percent.
4. Electromagnetic Ballasts: Comply with ANSI C82.1, energy-saving, high power factor, Class P, automatic-reset thermal protection.
5. Case Temperature for Compact Lamp Ballasts: 65 deg C, maximum.
6. Transient-Voltage Protection: Comply with IEEE C62.41.1 and IEEE C62.41.2, Category A or better.

C. Low-Temperature Lamp Capability: Rated for reliable starting and operation with ballast provided at temperatures 0 deg F (minus 18 deg C) and higher.

2.4 BALLASTS FOR HID LAMPS

A. Comply with ANSI C82.4 and UL 1029 and capable of open-circuit operation without reduction of average lamp life. Include the following features unless otherwise indicated:

1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C).
3. Normal Ambient Operating Temperature: 104 deg F (40 deg C).
4. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.

B. Auxiliary, Instant-On, Quartz System: Factory-installed feature automatically switches quartz lamp on when fixture is initially energized and when momentary power outages occur. System automatically turns quartz lamp off when HID lamp reaches approximately 60 percent of light output.

2.5 HID LAMPS

A. Metal-Halide Lamps: ANSI C78.43, with minimum CRI 65, and CCT color temperature 4000K.

B. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and CCT color temperature 4000 K.

C. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and CCT color temperature 4000 K.

2.6 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

A. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

B. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

3. Anchor-Bolt Template: Plywood or steel.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust luminaires that require field adjustment or aiming.

3.2 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.3 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole.
2. Install grounding conductor and conductor protector.
3. Ground metallic components of pole accessories and foundations.

3.4 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaire lowering devices.

END OF SECTION 265600

SECTION 270000 - STRUCTURED CABLING SYSTEMS

PART 1– GENERAL

1.1 PROJECT SUMMARY/OVERVIEW

A. The communication cabling contactor is to provide a complete communications cabling infrastructure system installation including but not limited to: Copper and Fiber backbone/riser system w/secondary protection, horizontal data and voice cabling with attendant terminations, mounting equipment, cable pathway and management systems, Ethernet switches, wireless access points system, testing and other items/materials, as specified in drawings, these specifications, and contract documents.

B. The items described herein shall not be substituted without the written consent of Sigma HN Engineers (consultant).

C. Communications Cabling Contractor shall be herein after referred to as Contractor for the scope of this document.

D. Contractor shall be responsible for all written specifications and drawings that correspond to this project.

E. These specifications are intended for bidding purposes only. No part shall be copied or used for any purpose other than bidding on this project.

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including Uniform General Conditions, Supplementary General Conditions, Architectural Plans and Specifications, requirements of Division 1, electrical, mechanical specifications and plans, and Telecommunications plans apply to the Telecommunications section and shall be considered a part of this section. The contractor shall read all sections in their entirety and apply them as appropriate for work in this section.

B. In order to accomplish the conditions of this agreement, the contractor shall perform the specific duties listed herein.

C. Contract Documents: Drawings and specifications are to be used in conjunction with one another and to supplement one another. In general the specifications determine the nature and quality of the materials, and the drawings establish the quantity guidelines, details, and give characteristics of performance that should be adhered to in the installation of the communications system components.
If there is an apparent conflict between the drawings and specifications, the items with the greater quantity or quality shall be estimated upon and installed. Clarification with the owner about these items shall be made prior to the ordering and installation.

D. Insurance: Prior to commencing work the Contractor shall procure at their own cost and expense insurance against claims for injuries to persons or damages to property by the Contractor, its agents, officers, employees, or subcontractors that may arise from or in connection with the performance of this Agreement. The policies will be available for review by the owner or consultant at any time during the agreement. These insurance policies shall be maintained and remain in full effect for the entire term of agreement.

E. Project and cost payment: Refer to general contractor contract documents and/or master specifications issued by architect.

F. Contractor will respect and protect the privacy and confidentiality of Owner, its employees, processes, products, and intellectual property to extent necessary, consistent with the legal responsibilities of the State of Texas and Owner policies.

G. Contractors shall sign a non-disclosure agreement and abide by the requirements to keep confidential all information concerning bid documents and this project

H. Use of subcontractors: Bidding contractors shall inform owner's contact and General Contractor in writing about the intention to use subcontractors and the scope of work for which they are being hired. Owner must approve the use of subcontractors in writing or owner's designated contact prior to the subcontractor's hiring and start of any work.

I. Contractor shall designate their project manager as the single point of contact and shall provide the name phone number and electronic mail information for the designated person. Project manager shall oversee all work performed to insure compliance with specifications as outlined in bid documents (which includes all specifications and drawings) to insure a quality installation.

1.3 SCOPE OF WORK

A. Contractor to comply with the master specifications documents and following requirements for a complete project installation.

B. This section establishes a communications infrastructure to be used as signal pathways for voice and high-speed data transmission. Provide a structured cabling system as described hereafter including but not limited to: communications outlets, fiber and voice riser/backbone cable, data and voice copper horizontal cabling, cable connectors, cable protection and terminations, and equipment racks/cabinets for networking hardware and cable termination patch panels.

C. Furnish all labor, materials, tools, equipment and services for the installation described herein. All requirements and specifications will be enforced. All cable pathways and runs to individual outlets are not shown in their entirety but shall be provided as if shown in their entirety. Where not specifically noted the contractor shall determine exact routing.

D. Installation procedures for communications cable will be such that the mechanical and electrical transmission characteristics of the specified cable plant and equipment are maintained.

E. Work of this Section covers a complete installation of both permanent and channel links for a Data and Voice Communications Network utilizing copper and fiber transmission media that includes, but is not limited to the following:

1. Installation and termination of secondary fused Building Entrance Terminals (BET's) for protection of incoming Service provider or campus inter-building copper pair circuits. Interconnection to Service provider demarc shall be coordinated with communications consultant, switch provider, service provider and client's IT representative on a later date. All copper pairs entering the building from an outside distribution network will be fuse protected. Coordinate with owner/consultant for the specific type of fused protection.

2. Provide and install Inner - duct rated appropriately for the installation location, verify with architect for plenum and riser rated areas.

3. Provide, install, terminate, test, and document all fiber and copper backbone and riser cable.

4. Provide, install, terminate, test, and document all fiber and copper voice and data horizontal cable.

5. Provide and place all termination devices such as but not limited to: Modular patch panels, termination blocks, information outlets, phone jacks, fiber distribution panels and fiber splice modules.

6. Provide, in quantities specified, interconnect components such as but not limited to: Copper patch cords; cross connect wire, fiber patch cables and data station cables.

7. Provide and place horizontal and vertical cable support devices such as but not limited to: Cable tray, flex tray, D-rings, J-hooks, Cable saddles, and all required mounting hardware, unless otherwise noted.

8. Provide and install all equipment mounting racks and cabinets.

9. Provide and install all rack mounted vertical and horizontal cable management panels

10. Provide and install approved fire-stopping systems in all communication pass-through spaces, conduit and cable tray wall and floor penetrations. Fire stop systems will be coordinated with General Contractor/Architect.

11. Grounding and bonding of racks, cable ladder and tray in MC and TR rooms to the grounding bus provided by Div. 26.

12. Provide complete documentation and demonstration of work.

13. Resolution of all punch list deficiencies within 10 working days.

14. Provide organized complete 100% Test Results of all copper and fiber cable and their components.

15. Produce final drawings of record.

16. The Owner may separately purchase and/or provide certain equipment and miscellaneous items that will be installed during the course of trim work. Such items may not be indicated in the Documents. Contractor shall cooperate with the Owner and his Suppliers.

17. The furnishing and installation of computer hardware and related networking software and equipment.

18. The furnishing and installation of multi-port routers, hubs, and UPS in MC, SR and TR's.

1.4 WORKS AND MATERIAL BY OTHERS (NIC) INCLUDE:

A. The Telecommunications Grounding Buss bars and grounding conductors connecting to main building electrode system to be provided on this project by Division 26.

B. The dedicated electrical power panels, isolated/non-isolated, emergency circuits and utility outlets to be provided by Division 26.

C. The furnishing, installation and finishing of plywood backboards to be provided by others. (Div.16000) Plywood installation will be coordinated with the General Contractor/Architect.

D. Building mechanical ductwork, HVAC system, and environmental control sensors to be provided by others.

E. The communication pathway devices such as, but not limited to: cable tray, flex tray, conduits, conduit sleeves, and wall and floor penetrations in corridors, office spaces, and open areas to be provided by Division 26.

1.5 STAFFING

A. Qualification: Submit an up-to-date and valid certification (Leviton-Bertek Oasis) verifying the qualifications of the
Contractor and installers to perform the work specified herein at time of bid submission.

B. Contractor shall have a complete working knowledge of low voltage cabling applications such as, but not limited to: data, voice and video network systems.

C. Contracting firm shall have installed similar systems in at least (10) other projects in the last five years prior to this bid and be regularly engaged in the business of installation of the types of systems specified in this document. Contractor shall provide information on prior projects including, but no limited to: items such as name and location of project contacts and numbers, total square footage, total number of cables/drops, types of media, etc.

D. All installer personnel assigned to this project shall be listed in the qualification questionnaire document. Eighty percent (80)% shall have a minimum of 3 years experience in the installation of the types of systems, equipment, and cables specified in this document prior to this bid. Any personnel substitutions shall be noted in writing to Sigma HN Engineers prior to commencement of work.

E. Contractor shall submit evidence of compliance with these requirements prior to beginning work on the project.

F. Cabling installers shall be trained by manufacturer and certified for Telecommunication cabling installations and maintenance of specified materials. Contractor shall include in his bid certification documentation. Contractors must be certified at the time of bid submission. Post bid certifications will not be acceptable.

1.6 ADMINISTRATIVE REQUIREMENTS AND COORDINATION

A. Project meetings: Contractor shall provide a person (name, contact phone number and e-mail address) for coordination with Telecommunication Consultant and Owner.

B. Coordinate work of this section with Owner's telephone system specifications, telephone instruments, workstations, equipment suppliers, and installers.

C. Coordinate installation work with drop ceiling vendors to coordinate cabling installation time frame in relation to drop ceiling installation. Resolve procedures and installation sequence for both installations. The result of this coordination will be to eliminate as much as possible loss or damage to ceiling materials, associated hardware, and delays to the project. Damage by contractor to the ceiling installation will be remedied at the contractor's expense in a timely manner.

D. Exchange information and agree on details of equipment arrangements and installation interfaces.

E. Record agreements reached in meetings and distribute record to other participants.

F. Adjust arrangement and locations of distribution frames, patch panels, and cross-connect blocks in equipment rooms and racks to accommodate and optimize arrangement and space requirements of any service provider equipment, telephone system, and LAN equipment. Tasks shall be coordinated with owner or his representative, and other trades' installations.

G. Where installed, confirm exact locations and method of mounting outlets in modular furniture. Follow furniture manufacturers written instructions for cable and installing devices in modular partitions. Obtain modular furniture and power pole locations from General Contractor/Architect. Wiring locations noted in plans along walls for modular furniture are approximate and will have to be determined by contractor at time of installation. Field condition adjustments for installation may have to be made.

H. When requested by owner or owner's representative furnish extra materials that match specified products and that are factory packaged with protective covering for storage and identified with labels describing contents.

1.7 CONTRACT ADMINISTRATION

A. Change orders shall be submitted to the consultant/client representative or GC complete with price breakdown and description. No work related to any change order will commence until approved.

B. The Contractor will attend all scheduled progress meetings with Owner representative, Architect, Telecommunication Consultant and General Contractor. It is possible that all parties may not be represented at every meeting.

1.8 PERMITS AND LICENSE

A. Contractor shall supply all State, City and County Telecommunication Cabling Permits required by appropriate governing agency.

B. Contractor shall be State Licensed and/or bonded for Telecommunication Cabling Installation and to comply with the State of Texas requirements.

C. The Owner or their representative will verify the above and determine any additional requirements.

1.9 ALTERNATES, SUBSTITUTIONS AND CHANGE ORDERS

A. If the Contractor proposes an alternate material that is equal to or exceeds specified requirements, Contractor shall provide manufacturer's specifications in writing to owner/engineer for approval 10 days prior to bid.

B. Contractor shall provide a complete cabling infrastructure according to these written specifications and drawings. If the Owner changes the scope of work to be performed by the Contractor, it shall be in writing. Contractor shall respond to these changes with a complete material list, labor, and taxes in writing presented to the Owner for approval within ten (10) working days. Contractor shall not proceed with additional scope of work without a signed approval by the Owner.

C. Owner will not pay for any additional work performed by the Contractor without signed approval of these changes. Submit a copy of signed change order upon billing.

D. A complete price breakdown itemizing all additional material and labor costs shall be submitted to the owner/consultant with the change order.

1.10 CODES AND STANDARDS (REFERENCES):

A. Codes: Comply with applicable sections of the following for interior and exterior installations.

a. Ensure you are using the latest and most current standards and regulations applicable. Uniform Building Code (UBC) and International Building Code (IBC)

b. National Electrical Code (NEC/NFPA 70, 2008) National Electrical Safety Code (NES IEEE C2-1997)

c. IEEE Std. 1100-1999 Recommended Practice for Powering and Grounding Sensitive Electronic equipment.

d. Local Codes, amendments, and ordinances.

B. Standards: Comply with the most recently published applicable sections of the following for installation and testing of communication cabling and connectors:

a. ANSI/TIA/EIA-568-B.1-2001: Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.

b. ANSI/TIA/EIA-568-B.2-1-2002: Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.

c. ANSI/TIA/EIA-568-B.3-2001 Part 3: Optical Fiber Cabling Components Standard.

d. ANSI/TIA/EIA-455-A-1991: Standard Test Procedures for Fiber Optic Cables. ANSI/CEA S83-596-1994: Fiber Optic Premises Distribution Cable.

e. ANSI/TIA/EIA-526-7-1998: Optical Power Loss Measurements of Installed Single Mode Fiber Cable Plant-OFSTP-7.

f. ANSI/TIA/EIA-526-14-A-1998: Optical Power Loss Measurements of Installed Multi Mode Fiber Cable Plant-OFSTP-14A.

g. ANSI/TIA/EIA-569-A-1998: Commercial Building Standards for Telecommunications Pathways and Spaces.

h. ANSI/TIA/EIA-606-1993: The Administration Standard for the Telecommunications infrastructure of Commercial Building.

i. ANSI/TIA/EIA-607-1994: Commercial Building Grounding and Bonding Requirements for Telecommunications.

j. TIA/EIA 758-April 1999: Customer-Outside Plant Telecommunications Cabling Standard.

C. Supervisors and lead installers shall have read the above documents and shall be familiar with the requirements that pertain to this installation. Installers shall be familiar with and have practical working knowledge of the requirements that pertain to this installation. The documents may be obtained from:

1. Global Engineering Documents, 15 Inverness Way East, Englewood, CO, 80112-5776,
800-854-7179, fax: 303-397-2740, http://global.his.com/

2. IEEE-Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY, 10017-2394, 800-678-IEEE, fax: 732-981-9667, http://standards.ieee.org/

3. NFPA: 1-800-344-3555- 11 Tracy Drive, Avon, MA 02322-9908

1.11 COMMUNICATIONS ABBREVIATIONS

BICSI: Building Industry Consulting Service International

C/W: Complete With.

CBC: Coupled Bonding Conductor

Div.1: Division 1 General Specifications

Div.15: Division 15 Mechanical Specifications

Div.16: Division 16 Electrical Specifications

EMI: Electromagnetic Interference.

GC: General Contractor

HC: Horizontal Cross-Connect.

IC: Intermediate Cross-Connect.

IDC: Insulation Displacement Connector.

I/O: Information Outlet.

LAN: Local Area Network.

MC: Main Cross-Connect.

MDF: Main Cross-Connect

(MC). N/A: Not Applicable.

NIC: Not In Contract.

OTDR: Optical Time Domain Reflectometer

RCDD: Registered Communications Distribution Designer

RFI: Radio Frequency Interference.

SR: Server Room

TBB: Telecommunications Bonding Backbone.

TBBIBC: Telecommunications Bonding Backbone Interconnecting Bonding Conductor

TBC: Telecommunications Bonding Conductor.

TBD: To Be Determined

TGB: Telecommunications Ground Bus Bar.

TMBC: Telecommunications Main Bonding

Conductor. TMGB: Telecommunications Main

Grounding Bus Bar. TR: Telecommunications Room.

UTP: Unshielded Twisted Pair.

1.12 SUBMITTALS:

A. Product Data: Include Manufacturer's data on features, ratings and performance for each component specified for approval prior to purchase and installation.

B. Drawings of Record: Shall be in AutoCAD format same version used by Architect/Consultant. Upon completion, submit facility floor plan drawings to consultant and/or owner upon request. Dimensions and scale of the drawing sheets submitted shall match the size of the drawing used for the contract documents, and shall include the following:

C. Dimensioned plan and elevation views of networking components including, but not limited to: outlet and raceway location, roughing-in diagrams and instructions for installation. Show access and workspace requirements.

1. One-line diagram of equipment/device interconnecting cabling for the data and voice systems.

2. Standard or typical installation details of installations unique to Owner's requirements.

3. Cable pathways, I/O's, rack numbering, equipment layout and numbering.

4. Submit one soft and one hard copy with project deliverables within 30 days of substantial completion.

D. Graphic symbols and component identification on detail drawing shall conform to the latest EIA/TIA 568-B, 606 and 607 conventions.

E. System labeling schedules, including electronic copies of labeling schedules, as specified below, in software and format selected/approved by Owner.

F. Samples: For workstation outlet connectors, jack assemblies, housing and faceplates for color selection and evaluation of technical specifications and requirements. Confirm with architect/interior designer/Owner representative for color before purchasing materials.

G. Product Certificates: Signed by manufacturer of cables, connectors, and terminal equipment certifying that products furnished comply with requirements.

H. Qualification Data: For firms and persons specified in "Quality Assurance" article. Provide evidence of applicable registration or certification.

I. Field Test Reports: Upon completion and testing of the installed system, test reports shall be submitted in booklet form and electronic media showing all field tests performed on, and adjustments to each/any component and all field tests performed to prove compliance with the specified performance criteria. Indicate and interpret test results in written form and verbally to Owner for compliance with performance requirements.

J. Contractor will provide maintenance data and manuals for: all products.

K. Warranty: Deliver manufacturer's sample of 15-year warranty of installed cabling system to include all components that comprise the complete cabling system.

1.13 RESUBMITTING

A. Contractor must clearly identify any resubmitted drawing sheets, documents or cut sheets either by using a color to highlight or cloud around resubmitted information. Maintain drawing numbering or page/sheet scheme consistency as per previously issued drawings/documents.

1.14 RECORDING AND COPYING TO DRAWINGS OF RECORD (AS-BUILT DRAWINGS)

A. The build-as drawings shall be developed from AutoCAD (version 2014) drawing files of Communications Design drawings to be supplied by Sigma HN Engineers.

B. As-built drawing submittals by the Contractor shall be in the same version AutoCAD format, as used by architect and consultant. Unless otherwise specified. This requirement currently is AutoCAD 2011.

C. The As-built drawings shall incorporate all changes made to the building identified in, but not limited to: Addendum, contemplated change notices, Site Instructions or deviations resulting from site conditions. Utilize normal recognized drafting procedures that match the AutoCAD standards, architect, and consultant guidelines and methodology. The Contractors as-built submittals shall include but not be limited to:

D. All communications data/voice outlet locations complete with outlet/cable labeling.

E. Cable routing paths of communications cables to identified infrastructure pathways.

F. All rack and cabinet locations and labeling there of.

G. All plan or elevation view changes to the MC/TR layouts.

H. Wall Field and patch panel layouts and cable assignments.

1.15 PRE-INSTALLATION CONFERENCE:

A. Contractor will attend and/or arrange a scheduled pre installation conference prior to beginning any work of this section (Data and Voice cabling).

B. Requests For Information (RFI): Contractor will submit questions in writing related to work to be performed, scheduling, coordination, etc. with consultant and/or project manager/owner representative.

C. Attendance: Contractors project manager/supervisor shall attend all meetings arranged by General Contractor, Owner's representatives, and other parties affected by work of this division 26.

D. All individuals who will be in an on-site supervisory capacity of installation personnel; project managers, supervisors and lead installers shall be required to attend the pre-installation conference. Individuals who do not attend the conference will not be permitted to supervise the installation of, or install, terminate, or test communications cables on the project.

1.16 DELIVERY/STORAGE AND HANDLING

A. Delivery, Loss, Storage, and Protection: All materials and equipment delivered and placed in storage shall be stored with protection from the weather, humidity, and temperature variation, dirt, dust, or other contaminants.

B. Coordinate deliveries and submittals with the Prime Contractor to ensure an organized timely installation.

B. Contractor shall be responsible for all handling and control of equipment. Contractor is liable for any material loss due to delivery and storage problems.

D. No equipment materials shall be delivered to the job site more than three weeks prior to the commencement of its installation. Coordinate with Prime Contractor on location for storage of materials.

1.17 VEHICULAR ACCESS, PARKING AND DELIVERY

A. Owner shall supply a designated parking location for Contractor to park their vehicles.

B. Contractor to provide orange safety cones at front and back of vehicles parked in owner assigned space. Vehicles shall be properly identified (labeled) with company logo and registered with general contractor/owner on site.

C. Owner is not responsible for any material, tools and/or company assets damaged due to theft/pilfering by others.

D. Provide a clean work area, which includes parking lot free from cable spools, boxes, trash/rubbish etc. Work areas will be cleaned daily.

E. Coordination with Delivery Company, driver, site address, and contact person will be the responsibility of the Contractor.

F. Contractor is responsible for prompt material deliveries to meet contracted completion date.

1.18 PRODUCT STORAGE REQUIREMENTS AND SITE ACCESS

A. Owner/General Contractor will assign a location or room to store telecommunication materials. B.

Contractor is ultimately/exclusively responsible for loss and/or damage to materials.

C. Contractor will have access to this site between the hours of 7am to 5pm. Monday thru Friday.

D. Extended work hours: If the Contractor desires to work after hours or weekends, Contractor shall provide a work schedule complete with dates, times, and individuals names to the Owner/General Contractor for approval.

E. Contractor will comply with provisions of Owner/General Contractor supplied list of job site security requirements.

1.19 PROJECT/SITE CONDITIONS

A. For all environmental recommendations, Refer to Master Architectural section.

B. For all security recommendations, Refer to Owner/General Contractor.

C. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

D. Contractor shall provide a clean work environment, free from trash/rubbish accumulated during and after cabling installation. Work area will be cleaned daily.

E. Contractor shall keep all liquids (drinks, Sodas, etc.) off finished floors, carpets, and tiles. If any liquid damages finished surfaces, Contractor shall provide professional service to clean or repair scratched/soiled finishes at their own expense.

1.20 EMERGENCY FACILITIES AND SAFETY

A. Contractor shall provide a minimum of two persons trained and certified in CPR and present during the cabling installation project. Provide CPR certification to Owner upon request.

B. Contractor shall conduct regular scheduled safety meetings within their team and/or coordinate same with GC on site. Contractor shall comply with all safety standards set by the GC.

C. All of the Contractor's vehicles on site shall be equipped with fire-retardant canister and first aid kit.

D. Contractor shall provide a minimum of one person equipped with a cell phone for emergency 911 calls and/or communications to local/main/central office safety staff. Designated person shall be on site at all times when work is being performed.

E. Communications contractor to coordinate other safety procedures with General Contractor and/or owner representative on site.

1.21 ASBESTOS

A. Existing Site Conditions: Interior/exterior finishes. Stop work and report immediately to the on site General Contractor representative if there is a suspicion of existing asbestos on the work site.

1.22 SCHEDULING

A. Construction schedule will be determined on a later date by General Contractor/Architect/Owner and/or communication consultant. Refer to master Architectural specifications.

1.23 ACCEPTANCE

A. Once all work has been completed, test documentation has been submitted, and Owner is satisfied that all work is in accordance with contract documents, the Owner shall notify contractor in writing of formal acceptance of the system.

B. Contractor must warrant in writing that 100% of the installation meets the requirements specified herein (Standards Compliance & Test Requirements).

C. Notification of the likelihood of a cable exceeding standardized lengths must be made prior to installation of the cable. Designer/consultants and Owners may agree to allow certain cabling runs to exceed standardized performance criteria (e.g. length). If it is decided to allow the

designated cable to exceed standardized lengths, such runs shall be explicitly identified and excluded from requirements to pass standardized tests. Tests for wire mapping, open, shorts, and grounds shall be made if other tests are waived.

D. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation soft and hard copies as described herein.

PART 2– PRODUCTS

2.1 WARRANTY AND CONDITIONS:

A. Contractor shall provide a minimum one (1) year warranty on installation and workmanship. B.

All materials are to be new and unused.

C. Pre-installation inspection:

1. Visually inspect all cables, cable reels, and shipping cartons to detect possible cable damage incurred during shipping and transport. Visibly damaged goods are to be returned to the supplier and replaced at no additional cost to the Owner.

D. All Contractors must be Manufacturer Certified and employ installers capable of an installation that falls under Manufacturer's guidelines necessary to obtain a minimum15-year Manufacturer's Warranty.

2.2 ACCEPTABLE MANUFACTURERS:

A. Only manufactures offering certified partnered system solutions for structured cabling, that carry a full manufacturer warrantee will be accepted.

B. Products:

1. Campus Copper Backbone (indoor/outdoor rated PE rated 22AWG):
   a. Leviton-Bertek

2. Campus Fiber Backbone (duct rated indoor/outdoor –FOCR12Y or FOCP12Y 10G (OM3)):
   a. Leviton-Bertek

3. Copper Riser Cable, Plenum rated:
   a. Leviton-Bertek

4. Fiber Riser Cable, Plenum rated: (FOPPX12Y)
   a. Leviton-Bertek

5. Horizontal Category 6A UTP, Plenum Rated, Blue in Color (Data)

a. Leviton-Bertek#10137384(10Gig) Plenum

6. Horizontal Category 6AUTP, Plenum Rated, White in Color (Voice)
   a. Leviton-Bertek#10137384(10Gig)

7. Fiber Termination shelves (Recessed Rack Mountable Multimode):
   a. Leviton-Bertek (Provide OPP-x 100i enclosure system, 12 port preloaded)

8. Fiber Termination shelves (Recessed Rack Mountable Single Mode):
    a. Leviton-Bertek (Provide OPP-x 100i enclosure system, 12 port preloaded

9. Caterogy6A Patch Panels (Recessed Rack Mountable - Data):
    a. Leviton-Bertek#49255-L24- (24 Port Flush Mount Panel)
    b. Leviton-Bertek#49255-L48- (48 Port Flush Mount Panel)
    c. Leviton-Bertek#6A10G-RY6 (Category 6A component rated (10Gig) Inserts)

10. Caterogy6A Patch Panels (Recessed Rack Mountable - Voice):
    a. Leviton-Bertek#49255-L24- (24 Port Flush Mount Panel)
    b. Leviton-Bertek#49255-L48- (48 Port Flush Mount Panel)
    c. Leviton-Bertek#6A10G-RY6 (Category 6A component rated (10Gig) Inserts)

11. Category 6A UTP Patch Cords (white for voice and blue for data)
    a. Leviton-Bertek# 6AS10-05L (5-feet elecom rooms)
    b. Leviton-Bertek#6AS10-07L (7 feet workstations)
    c. Leviton-Bertek#6AS10-10L (10 feet)

13. Fiber Duplex Patch Cables
    a. Leviton-Bertek # SLDC-M03(LC/LC Multimode Duplex Patch Cord)

14. LC/LC Singlemode Duplex Patch Cables
    a. Leviton-Bertek # UPDLC-S03 (LC/LC Singlemode Duplex Patch Cord)

15. Horizontal cable management (with doors)
    a. CPI Evolution #35441-702

16. Vertical cable management (with doors)
    a. CPI #35521-703 (double sided vertical cable manager)

18. Cross-Connect wire
    a. Leviton-Bertek

19. Fiber optic riser cable support (required for buildings with more than 3 levels)
    a. Hubbell: Basket weave wire/cable grips #022-29-X, or equivalent.

20. 19-inch two post racks

    a. CPI#55053-703 (19-inch 2-post 7-foot rack)

21. Cable runway and rack mounting hardware

    a. CPI

22. Above Ceiling Cable Supporting Hardware.
    a. Furnish and install the following:
    16 cables- CAT16HP 1”
    32 cables- CAT32HP 2”
    48 cables- CAT48HP 3”
    64 cables- CAT64HP 4”
    200 cables-CATHPBC200

    With the following mounting hardware:
    J-Hook clip to BC20 Beam Clamp
    CATHPTM J-Hook Tree mount bracket

CATHP4Z34 J-Hook rod/wire clip (bat wing)

23. Fire Stop systems (All Wall Sleeves)
    a. Specified Technologies Inc. (SPI-Easy Path Products)

24. Inner-duct
    a. Carlon
    b. ARNCO
    c. Endot

25. Grounding bus bars:
    a. Harger BICSI Pattern Telecommunications Ground Bar Kits
    b. Chatsworth BICSI & ANSI/EIA/TIA Grounding Bus-bars

26. Building Entrance Protection Terminators (BET): 110 in/out w/ five pin protection modules for all in-coming pairs
    a. Circa Enterprises Inc.
    b. Porta Systems Corp.

2.3 IDENTIFICATION PRODUCTS:

A. Cable Labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.

B. Provide transparent plastic label holders and 4-pair marked colored labels.

C. Install colored labels according to the type of field as per TIA/EIA color code designations.

D. Use TIA/EIA designation strip color-code guidelines for voice, data, cross-connect, riser, and backbone fields.

2.4 FIRE STOP PROCEDURES:

A. Provide fire resistant intumescent materials to restore fire ratings to all wall, floor or ceiling penetrations used in the distribution and installation for this communications cabling system.

B. Seal all penetrations through fire-rated barriers created by or made for or on behalf of the contractor to prevent the passage of smoke, fire, toxic gas, sound or water through the penetrations either, before, during or after a fire.

C. Fire stop materials shall be installed per manufacturer's instructions, be UL listed for intended use, and meet current NEC and local codes for fire stop measures.

D. The fire stop material chosen shall be distinctively colored to be clearly distinguishable from other materials, adhere to itself, and remain resilient and pliable to allow for the removal and/or addition of cable without the necessity of drilling holes in the material.

E. Provide and install removable, intumescent, fire-stop pillows in an approved fashion in all openings greater than 4 inches.

F. Provide and install manufacturer-approved methods for securing pillows.

G. Coordinate fire stop material, methods of installation, installation schedule, color, etc. with general contractor and electrical contractor on site.

H. Fire Stop Labeling: The contractor shall label each fire-stopped penetration with the following typical label;

!! WARNING!!
_____Hour Rating
FIRESTOPSEAL
DONOTDISTURB

NAME OF CONTRATORS COMPANY: _____
PHONE# - INSTALLER - _____ DATE _____
SUPERVISOR - _____ - DATE_____

TESTING

2.5 ACCESSORIES

A. The Contractor shall mount one hard copy, in color, 36"w x 24"h of a floor plan, clear plastic laminated, serving each communication room. Install the One-line drawings within a protective Plexiglas encasement on the wall of the servicing MC/TR/IC rooms. The Plexiglas encasement shall be in either flip-down format or file folder format for ease accessibility.

2.6 TEST RESULTS AND AS-BUILTS:

A. Contractor shall provide test results in soft copy for each cable with the date and time of testing shown. Copies shall be provided on CD. Copies shall be in MsOffice97/2000 spreadsheets.

B. Provide a minimum of two (2) hard copies of the above mentioned test results.

C. Contractor shall submit the approved and complete master "As-Built" drawing package in both hard and soft copies to the Owner and Sigma HN Engineers. The copies shall be in the same release of AutoCAD as provided by consultant and shall comply with drawing symbols, text styles, layering standards, drawing practices, etc. as set forth in consultant supplied files.

C. Provide a minimum of two (2) hard and soft copies of the as-builts.

2.7 QUALITY CONTROL

A. Materials: All materials shall be UL and/or ETL approved and labeled in accordance with NEC for all products where labeling service normally applies.B. Materials and equipment requiring UL 94, 149 or 1863 listing shall be so labeled. Modification of products that nullifies UL labels is not permitted.

C. All material and equipment as provided should be the standard Commercial-Off-The-Shelf (COTS) products of a manufacturer engaged in the manufacturing of such products. All shall be typical commercial designs that comply with the requirements specified. All material and equipment shall be readily available through manufacturers and/or distributors.

D. All equipment shall be standard catalogued items of the manufacturer and shall be supplied complete with any optional items required for proper installation.

E. Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections of optimum future performance and backward compatibility.

F. Expansion Capability: Unless otherwise indicated, provide spare conductor pairs in cables, positions in patch panels, cross connects, and terminal strips, and space in cable pathways and backboard layouts to accommodate 20 percent future increase in campus distribution and active workstations.

G. Backward Compatibility: The provided solution shall be backward compatible with lower category ratings such that if higher category components are used with lower category components, the basic link and channel measures shall meet or exceed the lower channel's specified parameters.

H. Component Compliance: The provided solution's components shall each meet the minimum transmission specifications listed herein such that no individual component will be less than specifications for permanent link and channel, regardless of the fact that tests for link and channel ultimately meet required specifications.

I. In the event of a breach of the representations and warranties contained herein, the Contractor, at their own expense, shall take all measures necessary to correct and make the cabling system work in compliance with the applicable manufacturer written technical recommendations and standards.

PART 3– EXECUTION

3.1 OBJECTIVE

A. The objective of this agreement is to provide a complete communications system cabling infrastructure installation for backbone, riser, cable protection, and horizontal data and voice wiring with attendant terminations, mounting equipment, materials, testing and other items as specified in drawings, these specifications, and contract documents.

B. COORDINATION AND COMPLIANCE

1. Contractor shall coordinate data/voice outlets, locations of cable tray, racks, etc. with the Architect, electrical, mechanical consultant drawings/documents before installation.

2. Contractor shall call for any inspections required by public agencies having jurisdiction in the area. Final payment of this contract will not be made until final inspections have been completed and all deficient items noted have been corrected.

3. The Contractor shall be responsible for complying with all local, state and federal laws or regulations applicable to the work to be performed, although said law; rule or regulation is not identified herein.

4. The contractor is responsible for any remaining construction materials; refuse within the area of work, and daily cleaning of the work area.

5. The Contractor will cooperate and coordinate with General Contractor and owner's representative to ensure the timely progress of all work.

6. Coordinate items or equipment components related to this project provided by the owner. Refer to section "Work and Material by Others" Items furnished by owner, installed by contractor: Communications contractor shall request of owner at the start of rough in any equipment not listed in this RFP to be installed by contractor.

7. Contractor shall be responsible for coordination with all trades, to include required scheduling of materials and/or equipment with Owner or general contractor for delivery and protection of equipment as required.

8. Refer to manufacturer's installation specifications and procedures for work to be accomplished by Contractor. The installation of cable, equipment, and materials will conform to manufacturer's specification to insure manufacturer's full warranty is in effect.

9. Contractor shall be responsible for review of all drawings of record to verify service requirements for proper installation of items.

10. The Contractor shall assume custody and responsibility for the items upon delivery and for determining that the contents are complete and in satisfactory condition for installation.

11. Salvage: Unless indicated otherwise, all items that must be removed due to interference with work of this contract remain the property of the Owner, and are to be salvaged at the Owner's discretion.

12. Remove all redundant (other) items from site at Contractor's expense.

13. Report percentage of work completed on a weekly basis.

3.2 EXAMINATION

A. Examination of building and site shall be the responsibility of the Contractor: Contractors shall examine site and building as required prior to quoting to determine any conditions affecting the work. Contact Owner for arrangements.

3.3 CABLE PLANT OVERVIEW

A. Contractor shall provide all labor and material for a complete Telecommunications Cabling Infrastructure (Fiber and Copper Cabling, Termination Hardware, Information Outlet, Testing, Labeling, and Warranty).

B. Campus Backbone: Fiber– Refer to plans for requirements.

C. Horizontal: -Refer to plans

D. Workstation I/O: See construction drawings for detail.

3.4 COMMUNICATIONS EQUIPMENT ROOMS

A. Telecommunications rooms are generally considered a floor-serving facility. This room shall be equipped with fiber and copper cables, wall mounted termination blocks/patch panels, rack mounted copper and fiber patch panel terminations, vertical and horizontal cable management systems and passive/active equipment racks. Contractor shall provide proper identifications/labeling scheme all passive components installed in these rooms.

B. Provide racks as shown on plans.

C. Brace and secure top of racks with appropriate hardware per manufacturer specifications. Racks will be secured to floor with a minimum of four ½" hex screws, flat washers, lock washers and anchors.

D. Attach grounding lugs to each rack, cable raceway, conduit, etc. in each MC/TR room.

3.5 VERTICAL AND HORIZONTAL MANAGEMENT

A. Vertical Wire Management shallbeofthesamemanufacturerastheequipmentracks installed and be double-sided vertical rack cabling sections (6"W x 8"D x 7'H with door). Equip each rack with 2 units, 1ea. mounted on the outside rails. Where more than one rack is installed in a single

location, provide one 10 inch unit (10"W x 13"D x 7'H with door) installed between the rack sections.

1. Horizontal Cable Management: Provide (3) two rack unit modules per cable management rack. Install such that horizontal wire management is located at the top of the cable management rack below fiber termination panel if present; in the center of the rack and at the base of the rack in both the front and back of equipment rack. Where more than one rack is installed in a single location, horizontal wire management shall be installed on the adjacent rack in locations that correspond to the locations described for patch panels above.

2. Backboard Cable Management: Provide wire management for cross-connect cable management from backbone and riser to horizontal cabling for all wall-mounted terminations. Mount above, below, and beside termination blocks as shown on communications detail drawing.

3.6 UTP PATCH PANELS

A. Cabling within MC/TR's, racks, and enclosures: provide adequate length of cabling. Train conductors to termination points that follow manufacturers' installation procedures for Category 6A standards. Provide lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

B. Provide 10% additional port capacity per Telecommunication Room typical.

C. Mount data patch panel and vertical/horizontal management hardware on 19" racks. Refer to drawings for guidelines for rack placement and cable management details.

D. Terminate cables in a logical ascending room number order, and consecutive number order within rooms typical.

3.6 FIBER TERMINATION PANELS

A. Provide all required tools, materials, consumables, and equipment necessary for field termination/mounting of hardware for connectors at outlets and/or fiber patch panel locations. Fiber strand termination type to be "LC" type terminations throughout.

B. Terminate fibers in a consistent, consecutive color-coded manner at each end. Use hardware manufacturers recommended color-codes.

C. Provide a minimum 36" slack of buffered fiber inside each fiber patch panel.

D. Provide a separate recessed fiber optic patch panel complete with a smoked glass front door for SinglemodeandMultimodeterminations.

E. Provide in MC/MDF/TR rooms a minimum of one each 12-port for multi-mode and one each 12-port single mode recessed rack mount fiber patch panel with a smoked glass front door complete with coupler panels (Fully Loaded) for backbone termination.

F. Provide in each TR room a minimum of one each 12-port, recessed rack mount fiber enclosure with a smoked glass front door complete with module adapters and "SC" connectors (Fully Loaded) for riser termination.

G. Terminate Single-mode fiber with “LC” connectors. Refer to patch cords

section.

H. Terminate Multi-mode fiber with “LC” connectors. Refer to patch cords section.

3.7 VOICE TERMINATION BLOCKS

A. Provide Category 6A/110 termination blocks for rack-mounted voice riser cable termination, complete with labeling strips, bracket kit, distribution rings, etc and or as specified on plans.

3.8 CABLE LADDER RACK

A. Provide at each MC/TR room horizontal cable runways. Refer to Communications drawings for location and size of each runway. Securely attach to wall studs (and racks if applicable) with support brackets, complete hardware components in accordance with manufacturers written instructions.

B. Cable runway radius Bend: Per manufacturers/NEMA specifications.

C. Use cable runway E-Bend 12” or equivalent where required: Refer to drawings.

D. Contractor shall provide all connection, supporting and grounding hardware for a complete overhead cable runway system.

3.9 CABLE SUPPORT STRAPS, POWER STRIPS AND RACK MOUNT UPS

A. Provide hook and eye type (Velcro) cable management straps for horizontal (voice/data) cables: Provide sufficient quantities to wrap all cable at minimum 6 foot intervals in MC and TR’s.

B. Use proper methods for routing and securing backbone, and riser cables in a neat, secure manner. Securely retain the cable bundle with Tak-Tape cable ties.

C. Provide as noted on plans power protection strip for each 19” rack c/w surge protection. Refer to communication drawings 19” rack details.

D. Furnish and install rack mounted APC Un-interruptible Power System, (UPS) in each TR (Minium of
2 Kw) coordinate location, type, and rating of receptacle with Div-26. Refer to communication drawings rack detail.

3.10 COPPER PATCH CORDS

A. Copper: Provide equal amounts of blue 5 foot Category 6A patch cables for 75% of the terminated horizontal data cables in the telecommunications rooms. Patch cables shall be from the same manufacturer as the structured cabling system. Coordinate with owner/consultant prior to procurement.

B. Provide equal amounts of blue 7 foot Category 6A patch cables for 75% of the terminated horizontal cables at the work areas. Patch cables shall be from the same manufacturer as the structured cabling system. Coordinate with owner/consultant prior to procurement,

3.11 FIBER PATCH CORDS

A. Fiber: Provide three twelve (12) foot SM and three twelve (12) foot 62.5/125 um MM duplex fiber jumpers for each TR and Server Room (12 total of each fiber type). Coordinate connector type with owner/Consultant prior to purchase.

B. Patch cords shall be made and warranted by the manufacturer of the cabling system installed in this project and shall meet or exceed Fiber patch cord specifications as outlined in EIA/TIA standards.

C. Patch cords shall be in original packaging when presented to the owner (i.e. sealed plastic bags).

3.12 GROUNDING

A. Provide compression type ground lugs for each 19" rack or cabinet. Rack shall be grounded to wall mounted ground bus bar using #6 AWG stranded, insulated copper conductor. Furnish all required bonding material and hardware; follow NEC / ANSI/TIA/EIA -607 manuals for bonding procedures and specifications.

B. Ground all Telecommunication hardware inside all communication rooms and wall mounted cabinet areas like, but not limited to: cable ladder, conduit, equipment racks, protection units and shielded cabling with #6AWG stranded insulated cable.

C. Ground all Building Entrance Terminal equipment per manufactures specifications.

3.13 PLYWOOD BACKBOARDS

A. Provided by General Contractor and/or Division 26, 8'H x 4'W x ¾"T vertically hung, grade AC, plywood in MC/TR rooms as indicated on plans. Paint plywood backboards with two coats of fire retardant white or light gray paint. Coordinate with Architect, Prime Contractor, Division 26 and Owner for installation of backboard. Refer to drawings for proposed location and details.

3.14 MAIN DISTRIBUTION FRAMES AND SERVICE ENTRANCES

A. Entrance: Protection related hardware. Contractor shall coordinate location/placement of hardware to be mounted on plywood backboards with Owner and service provider before mounting hardware to insure proper layout and requirements. Coordinate with owner's representative and service provider prior to purchase and installation to verify need.

B. Provide secondary protection modules (110-in/out type) or (66-in/out type) and or as specified on plans for all incoming pairs at both termination points, complete with solid-state 5 pin protector modules. Securely attach protector housing to wall mounted plywood backboard. Refer to communications drawings for proposed location.

C. Provide 50 pair cable whips between protector unit and termination block for voice cross-connection.

D. Ground Protection unit to ground bar with #6AWG stranded insulated wire and or as specified on plans.

E. Ground Duct Rated Cable with a B-Bond clamp and #6AWG stranded insulated cable to ground bus bar within 50 feet of entering the building.

F. Provide cable runway in MC/TR/MDF Server room above all racks and up to runway/conduits/sleeve's entering room from corridors to form a complete runway system connecting all hardware installations. Refer to drawings for details.

3.15 FIBER AND COPPER SPLICING REQUIREMENTS

A. Fiber and copper riser cables shall be continuous from end to end with no bridges, taps or splices. No splicing is allowed.

3.16 INTERIOR COMMUNICATION PATHWAYS

A. Cables shall be neatly bundled along common paths. Maximum number of cables per bundle shall be determined by supporting hardware manufacturer recommendations.

B. Use only pathway and spaces designed for telecommunications.

C. Provide a minimum of 20% spare capacity in all vertical/horizontal

chases. D. Mechanical and power separation. Install communications cabling:

1. Minimum of 3 feet from electrical panel boards, photocopier.

2. Minimum of 6 inches from fluorescent fixtures

3. Minimum of 6 feet from electrical motors.

3.17 CONDUITS

A. All information outlets shall have a minimum of one 1" conduit provided from the recessed deep box to the nearest "Zone" pull box or to within 18 inches of the closest cable tray. (By electrical contractor)

B. There shall be a maximum of two (2) 90° degree bends per conduit run, between any two adjacent pull boxes.

C. No conduit run shall exceed 100 feet between pull boxes.

D. Electrical contractor shall provide conduit path (sleeves) where cabling passes through fire rated walls\deck\slab. Seal penetration with intumescent fire-stop material that matches the rating of the surface penetrated. Coordinate fire stopping with Division 16000 and general contractor on site.

E. Electrical contractor shall secure conduit sleeves with minimum 12" long "Uni-strut" or equivalent (support) channel at both sides of wall. Complete installation with "Uni-strut" or equivalent conduit retaining straps sized for the conduit being installed.

F. Electrical contractor in coordination with architect and general contractor shall provide accessible entry and exit points in all vertical and horizontal cable chases so as to provide working space to install and maintain cable infrastructure.

G. Do not install communication cables in conduits until all bushings/couplers are installed on the ends of the conduits.

H. Contractor shall ground all incoming communication conduit/tray into the MC and TR rooms with minimum #6AWG green insulated jacket, copper conductor or as noted on plans.

3.19 SURFACE MOUNT RACEWAY, TELECOMMUNICATION, AND PACK POLES

A. If used system furniture vendor shall supply vertical telecommunication and power pack (power pole) between modular furniture and drop ceiling. This will ensure capacity, color matching and installation continuity for modular furniture.

B. Contractors to confirm exact locations and methods of mounting outlets in modular system furniture.

3.20 CABLE SUPPORT HANGERS AND FIBER SUPPORT HANGERS

A. Cable Saddles and J-hooks: Cable Saddles or "J"-Hook cable support systems for horizontal cabling shall be installed. Refer to drawings for requirements.

All horizontal cabling shall extending from the offices to the corridors shall be in continuous conduit complete with bushings and connecting hardware from the I/O to within 18 inches of the cable runway system (Division 26)

B. Provide threaded rod and/or #8AWG wire for supporting hangers when hanging conduits/trays, etc. from floor deck or deck members. Refer to manufacturers' recommendation for proper installation, sizing, and loading of hangers.

C. Minimum 1/2" diameter threaded rod or equivalent and "Uni-strut" or equivalent channel shall be used for hanging cable runway from floor deck or deck members. Follow manufacturer recommendations and standards. Refer to communications drawings for details.

D. Cables shall be neatly bundled using hook and eye (Velcro) type cable straps along common paths. Maximum number of cables per bundle shall not exceed twenty-four 4 pair UTP.

E. Layout cable runs in advance to determine quantities of cable to be installed along pathways, and to insure non-interference from other trade installations.

F. Maximum-stacked height of cable installed in cable runway shall not exceed 2-1/2". Increase width of runway or provide additional runs of cable runway where required to fulfill requirements.

G. Do not support cables from or lay on ceiling suspension system. Do not use electrical, plumbing, or other pipes for support. Cable supports shall be permanently anchored to building structure or substrates. Provide attachment hardware and anchors designed for the structure to which attached, and that are suitably sized to carry the weight of the cables to be supported. Confirm with Architect and/or Prime Contractor on installation procedures for Cable Support System prior to implementation. No exceptions !

H. Secure and support exposed horizontal cable at intervals not exceeding 4ft and not more than 18 inches from cabinets, pack poles, boxes, fittings, outlets, racks, frames, and terminals. The exception is in a vertical drop into a pack pole above a drop ceiling where the distance between supports shall not exceed 4ft.

I. Support vertical fiber optical cable with Basket weave wire/cable grips – Hubbell #022-29-X or equivalent. Support fiber riser with single weave support grip with a single offset eye. Mount/attach pulling eye to a wall or ceiling deck secured hook to support and provide strain

relief to riser cable. Provide a minimum 36" loop of fiber prior to entering fire stopped floor sleeve.

J. Where pull is required coil up slack fiber cable into pull box and secure with single weave support grip. Refer to communications drawings.

3.21 INNERDUCT (Not required)

A. Provide separate duct rated innerduct for backbone/campus fiber optic cable runs that are routed throughout this building. A minimum one (1), 1-inch duct rated innerduct per cable. Exemption: innerduct is not required if fiber cable is encased in flexible steel Armour and complete with plenum rated orange jacket. Coordinate with owner prior to purchase. Refer to communications drawings detail.

B. Install fiber optic data cables in continuous lengths, unless specified otherwise. Refer to communications drawings.

C. All fiber optic riser cables shall be in innerduct unless otherwise specified. Fill all open fiber conduits with separate innerduct quantities listed below.

1. Provide three (3) innerducts per 4-inch conduit as follows: Two (2) 1-inch and one (1) 1 1/4-inch innerduct.

2. Provide two (2) innerducts per 3-inch conduit. One (1) 1-inch and one. (1) 1 1/4-inch innerduct.

3. Provide one (1) innerduct per 2-inch conduit. One (1) 1 1/4-inch innerduct.

D. Provide one (1) 1-inch innerduct for fiber installation in existing conduit that has been currently installed with other telecommunication cabling. Ensure conduit fill ratio is maintained.

E. Riser, and horizontal fiber optic cabling running in accessible (open) ceiling space shall be provided in a separate plenum rated innerduct. Refer to drawings.

3.22 BACKBONE CABLING REQUIREMENTS

A. Provide a 10-foot service loop for copper backbone/riser cables in MC and TR's. Locate loop at deck or on bottom of cable runway.

B. Provide a 10-foot service loop for fiber optic cables at each rack in MC and TR's. Locate loop at deck or on bottom of cable runway.

C. Limit cable-bending radius to 20 times the cable diameter during installation, and 15 times the cable diameter after installation.

D. Installation: Fiber backbone cables shall comply with ANSI/EIA/TIA specifications for single mode and multimode cabling.

E. Pull cables in smooth and regular motions using methods that prevent cable

kinking. F. If necessary use an approved communications cable pulling lubricant.

G. To reduce the occurrence of micro bending of individual fiber strands, use mesh-type, swivel-

eye fiber optic pulling grips. This type of pulling grip is recommended for all cable pulling complete with breakaway swivel at 600lbs of pulling tension.

H. Conduit fill shall not exceed 40%.

3.23 COPPER BACKBONE/RISER INSIDEPLANT: refer to plans for

requirements.

3.24 FIBER - GENERAL REQUIREMENTS:

A. The Cable shall meet the requirements of the National Electrical Code, Article 770, Bellcore Generic Requirements for Fiber and Optical Cable (GR-20). The cable shall also meet the following standards, where appropriate; TIA/EIA 568-A "Commercial Building Telecommunications Wiring Standard" ICEA-83-596-1988 Insulated Cable Engineers Association Standard for Fiber Optic Premises Distribution Cable Publication S-83-596, December 1988, ANSI X3.166-1990 Fiber Data Distributed Interface (FDDI)- Token Ring Physical Layer Medium Dependent (PMD), Bellcore Generic Requirements for Premises Fiber Optic Cable (GR-409- CORE), and Section 6, Central Member and IEEE 802.3-Gigabit Ethernet.

B. The cable manufacturer shall be ISO 9001 Certified.

C. Cable Construction: The cable shall be constructed using 900 micron buffered fibers stranded around a central member. The combined unit shall be helically surrounded by water blocking Aramid yarn. The cable will have a ripcord and a flame retardant, polyethylene overall jacket. The cable shall be constructed to the specifications defined in "Premises Cable Specifications".

F. Central Member: The central member shall be a glass/epoxy composite dielectric rod, which functions as an anti-buckling element for cables with six (6) or more fiber. The central member shall be coated yarn for cables with a fiber count of four (4).

3.25 OPTICAL FIBERS:

A. Single Mode Fibers: The cable shall contain 50/125 micron single mode fibers. Single-mode fibers shall meet the specification defined by "Tight Buffer Single-Mode Optical Fiber Specifications".

B. Multimode Fibers: The cable shall contain 62.5/125 micron multimode fibers. Multimode fibers shall meet the specifications defined by "Tight Buffer Multimode Optical Fiber Specifications". Coordinatewithowner/consultantforexactstrandcountandfibertype.

C. Buffering: All optical fibers shall be buffered to 900 ± 30 µm. The buffering material shall be a low smoke, zero halogen, flame-retardant polyethylene thermoplastic material. The strip force to remove buffer and coating must be in the range of 1.0 to 2.5 lbs, tested with a digital force gauge, and shall be removable with readily available tools without damage to the optical fiber. PVC based buffer materials are strictly prohibited because of their halogen content and susceptibility to failure in the outside plant environment.

D. Fiber Identification: Each fiber shall be distinguishable by means of color-coding in accordance with ANSI/TIA/EIA-598-A "Optical Fiber Color Coding".

1. 1 to 12 Fibers: The fibers shall be distinguishable from each other by means of color-coding. The color-coding sequence shall be blue, orange, green, brown, slat, white, red, black, yellow, violet, pink, and aqua.

2. 13 to 24 Fibers: The fibers shall be distinguishable from each other by means of color-coding. The color coding sequence shall be blue with black striping, orange with black striping, green with black stripping, brown with black striping, slate with black striping, white with black striping, red with black striping, black with white striping, yellow with black striping, violet with black striping, pink with black striping and aqua with black striping.

E. Stranding: The fibers shall be stranded using a reverse oscillating lay (SZ) stranding method.

F. Primary Strength Member: The primary strength member shall consist of Aramid yarns applied helically around the cable core.

G. Water Blocking: The Aramid yarn will be impregnated with super absorbent polymers for water blocking. The polymer material must be reversible and recoverable.

H. Ripcord: The cable shall incorporate a ripcord under the jacket to facilitate jacket removal and allow easy access to the fiber.

I. Cable jacket: The jacket material shall be a low smoke, zero halogen, flame-retardant polyethylene thermoplastic material. The jackets shall be continuous, free from pinholes, splits, blisters or other imperfections.

J. Jacket print: The cable jacket shall be printed with manufacturer name, sequential length marking, the number and type of fiber and the appropriate cable Type marking according to NEC Section 770.

K. Jacket Removal: The cable jacket shall be designed for easy removal, with readily available tools. The cable design shall permit jacket removal without damage to the optical fibers.

L. Code rating: Cables intended for installation in vertical runs in a shaft or from floor to floor will meet the requirements of the National Electric Code, Article 770 and UL 1666. The jacket will be marked with ‘OFNR” and the appropriate UL file number.

M. Minimum Bend Radius: The minimum bend radius for unloaded, installed cable, shall be 10 times the cable outside diameter. The minimum bend radius for loaded, cable during installation shall be 20 times the cable outside diameter. O. No mechanical damage shall occur to the cable jacket.

P. Tensile Strength: Cables subjected to the minimum rated tensile load defined in GR-409-CORE, Section 6.3.6 (Tensile Strength of Cable) shall not exhibit an increase in attenuation greater than specified by GR-409-CORE, Section 6.3.2.

Q. Testing shall be done in accordance with TIA/EIA-455-33A, Fiber Optic Cable Tensile Loading and Bending Test.

R. Cable Twist: The cable shall be capable of withstanding mechanical twisting without experiencing an attenuation increase greater than specified by GR-409 CORE, Section 6.3.2. After the cable is subjected to the twist test, the cable jacket shall not exhibit evidence of cracking or splitting when observed under 5x magnification.

S. Testing shall be done in accordance with TIA/EIA-455-85A, Fiber Optic cable Twist Test.

T. Cable Cyclic Flexing: The cable shall be capable of withstanding mechanical flexing without experiencing an increase in attenuation greater than specified by GR-409-CORE, Section 6.3.2. After the cable is subjected to the flex test, the cable jacket shall not exhibit evidence of cracking or splitting when observed under 5xmagnification.

U. Testing shall be performed in accordance with EIA-455-104A, Fiber Optic Cable cyclic test. The cable shall be flexed for the number of cycles specified below and the sheave diameter shall be a maximum of 20 times the cable diameter.

V. Multi-Mode Fiber Optic Cable Geometrical Parameters:

1. Core Diameter: The core diameter shall be 62.5 ± 3 µm. The core diameter shall be measured in accordance with EIA-455-45 A, Microscopic Method for measuring Fiber Geometry of Optical Wave guides. Refer to drawing for exact specifications. Coordinate with Owner/Consultant for confirmation of fiber type for this project prior to procurement.

2. Core Non-Circularity: the core non-circularity shall be less than or equal 6%.

3. Cladding Diameter: The cladding outside diameter shall be 125 ± 2 µm. The cladding diameter shall be measured in accordance with EIA-445-45A, Microscopy Method for Measuring Fiber of Optical Wave guides.

4. Cladding Non-Circularity: The Cladding non-circularity shall be less than 1%. Measurements shall be in accordance with EIA-455-45A, Microscopic Method for
Measuring Fiber Geometry of Optical Waveguides.

5. Core/Cladding Concentricity Error: The offset between the center of the core and the center of the cladding shall be less than 1.5 m.

6. Coating: The coating shall be a U.V. curable acrylate. The coating shall be readily removable with commercially available stripping tools. Measurements shall be in accordance with EIA-455-55A, Methods for Measuring the
Coating Geometry of Optical Fibers.

7. Coating Non-Circularity and Concentricity Error:The coating non-circularity shall be less than or equal 6%.The coating concentricity error shall be less than or equal12.5 µm

8. Parameters: Fiber tensile Proof Test: The individual fibers shall be subjected to minimum proof stress of 0.70 GN/m² (100 Kpsi). Testing shall be in accordance with EIA-455-31A.

W. Single-Mode Tight Buffer Optical Fiber Specifications: Optical Parameters:

1. Attenuation: The Attenuation, of the cabled fiber, shall not exceed 0.7 dB/km at 1310 nm and 1550 nm. Attenuation measurements shall be made in accordance with either EIA-455-78 (Spectral Attenuation Cutback Measurement for Single-Mode Optical Fibers) or with EIA-455-59 (Generic Description of Optical Time Domain Reflectometry).

2. Attenuation Variation: The attenuation variation shall be less than 0.1 dB/km for wavelengths between 1285 nm and 1330 nm compared to the attenuation at 1310. The attenuation variation shall be less than 0.5 dB/km for wavelengths between 1525 nm and 1575 nm compared to the attenuation at 1550 nm. Attenuation variation measurements shall be made in accordance with EIA-455-78, Spectral Attenuation Cutback Measurement for Single-Mode Optical Fibers.

3. Attenuation at Water Peak: The attenuation shall not exceed 2.0 dB/km at 1383 nm ±3nm.

4. Attenuation Uniformity: The attenuation discontinuity shall not exceed 0.1 dB at 1310 nm or 1550 nm throughout the cable length.

5. Attenuation Uniformity measurements shall be made in accordance with EIA-455-59, Generic Description of Optical Time Domain Reflectometry.

6. Macro Bending Attenuation: The maximum induced attenuation shall be less than or equal 0.5db at 1310 nm and 0.10 dB at 1550 nm when wound 100 turns on a 75 mm diameter mandrel.

7. Index of Refraction: The effective group index of refraction will be 1.466 at 1310nm and 1.467 at 1550 nm.

8. Chromatic Dispersion: The zero dispersion wavelengths shall be between 1300 to 1332 nm and the nominal zero dispersion wavelengths should be 1310 nm. The maximum value of the dispersion slope shall not be greater than 0.092-psec/ (nm^2/km) at the zero dispersion wavelength. The dispersion measurements shall be made in accordance with EIA-455-168, Chromatic Dispersion Measurement of Multimode Graded-Index and
Single-Mode Optical Fibers by Phase-Shift Method, or EIA-455-175, Chromatic Dispersion
Measurement of Optical Fibers by the Differential Phase Shift Method.

9. Cut-off Wavelength: the cut-off wavelength shall be 1250 ± 100 nm for Depressed Clad fiber and 1260 ± 100 nm for Matched Clad fiber.

10. Mode Field Diameter: The nominal mode field diameter, for Depressed Clad Fiber, shall be 8.8 µm ± 0.5 µm using a measurement wavelength of 1310 ± 20 nm, the nominal mode field diameter shall be 9.7 ± 1.0 µm. The nominal mode field diameter, for Matched Clad fiber, shall be 9.3 µm ± 0.5 µm using a measurement wavelength of 1310
± 20 nm. At 1550 ± 20 nm, the nominal mode field diameter shall be 10.5 ± 1.0 µm.

3.26 FIBER BACKBONE/RISER INSIDE PLANT

A. Riser Premise Optical Fiber cable Tight Buffer Optical Fiber Plenum/Riser Cable: 62.5/125µm Multimode and 8.3/125µm Singlemode Tight buffer cables. Coordinate with Owner/Consultant for exact strand counts and fiber type.

B. Provide 24 strands of Multimode and 24 strands of Single-mode tight buffer Fiber optic riser cable between the TR room and the building server room. Refer to the construction drawing for additional detail.

3.27 CABLE CLEANER AND CABLE PULLING LUBRICANTS

A. Cable cleaners and/or lubricants shall be materials designed and manufactured for telecommunication cabling use.

3.28 HORIZONTAL CABLING REQUIREMENTS

A. Provide all necessary installation materials, hardware, tools and equipment to perform insulation displacement type terminations at all data outlets, patch panels, and voice termination materials. Furnish quantities required to terminate all UTP horizontal cables plus percentage.

B. Cabling Method: Provide cabling in acceptable spaces, cable tray, (surface and/or enclosed raceway), or conduit, cable support system. Within consoles, racks, cabinets, desks, and counters, in accessible ceilings spaces and in gypsum board partitions where open cable method may be used. Use UL or ETL listed plenum rated cable in all spaces. Conceal raceway and cabling except in unfinished spaces.

C. Utilize conduits/cable runway as indicated on the drawings. All data and voice cables will be routed in a neat and orderly fashion. No cable ties or wraps shall be used to secure the cables in the runway outside of the MC and TR's.

D. Examine pathway elements intended for cable. Check raceways and other elements for compliance with space allocations, installation tolerances, debris, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Horizontal cabling when exiting runway and/or conduit shall thereafter be supported with approved materials and space supporting hardware to maintain performance characteristics.

F. Install cable using techniques, practices, and methods that are consistent with specified data cabling and the installed components and that insure specified performance levels of completed and linked signal paths, end to end.

G. Cable bundles brought into the MC/TR shall be routed and dressed in such a manner that prior to termination the cables are not subject to damage and misuse such as installers walking on the bundles that are lying on the floor.

H. Cable Pulling shall not exceed 25lbs of pulling tension typical.

I. Install Cables in continuous lengths from communications outlet to specified patch panels for data and termination blocks for voice.

J. Pull cables in smooth and regular motions using methods that prevent cable kinking.

K. Keep all items protected before and after installation with dust and moisture proof barrier materials/envelopes. If wiring is terminated on patch panels, data, voice jacks prior to painting, carpet installation, and general finish clean up, these jacks shall be placed in a protective envelope to insure dust, debris, moisture, and other foreign material do not settle onto jacks' contacts. Envelope will be removed on final trim out after other trades have finished their finish work. It shall be the contractor's responsibility to ensure the integrity of these protective measures throughout the life/installation of the project.

L. Do not bind cables tightly together with tie or other wraps. Wraps shall slip loosely around cables. Use Velcro wraps instead of cables ties for all cable bundling in the MC and TR's.

M. Pull cables without exceeding cable manufacturer's recommended pulling tensions

N. Pull cables simultaneously if more than one is being installed in the same raceway/pathway.

O. Use pulling compound or lubricant if necessary. Use compounds approved for lubricating telecommunications cabling that will not damage conductor or insulation.

P. Use pulling means; including fish tape, cable, rope, and basket weave wire/cable grips that will not damage media or raceway.

Q. Install open cabling parallel and perpendicular to surfaces or structural members following surface contours where possible. Cables shall be run above other ducts, pipes, and other installations. Provide surface mount raceway to protect all exposed cabling from damage, confirm with owner for color and manufacture style. No exception for exposed cabling runs.

R. Use no flat or under carpet communications cabling (UTC) without prior written permission of owner or communications consultant.

S. Separation of Wires: Comply with EIA/TIA-568-A rules for separating unshielded copper communication and data-processing equipment cables from potential EMI sources, including electrical power lines and equipment.

T. Maintain a minimum spacing of 18" from electrical feeders and/or branch circuit wiring.

U. Maintain a minimum spacing of 12" from auxiliary systems cabling.

V. Maintain a 1" separation where UTP cables must pass perpendicularly to electrical, plumbing, or other wiring, conduit, or piping systems. Use non-conduit bushings, if necessary to maintain separation, which allow for the addition of a reasonable number of cables in the future.

W. Maintain communications pathways away from electrical apparatus such as motor driven equipment and transformers, minimum separation distance of 10'-0" is recommended.

X. Terminate horizontal cables in consistent consecutive order. Arrangement of cables on patch panels and voice termination hardware shall be in ascending order of room numbers and outlet numbers within rooms. Numbering shall start at the left of the main door to the room and continue in a clockwise direction around the room. That is, start the wire termination on patch panels and blocks with the cables that are the lowest room number, and place them in the first patch panel and port number. In any building for example, a room 100 would be terminated first; room 101 would be terminated second, etc. The cables within the room will be terminated starting with the cables located to the left of the main door to the room and continue around the room in a clockwise direction.

Y. Provide 6" service loop for horizontal cables at I/O's. Locate service loop neatly with in outlet box. (Typical)

Z. Maintain twists in cable pairs to within ½" of termination.

AA. Group all specialty cables such as the pay phone cables, which do not have their own termination hardware, in one group, clearly labeled as to cable number and function, in the last positions on the horizontal cabling blocks in each MC/TR.

BB. Limit cable-bending radius to 20 times the cable diameter during installation, and 15 times the cable diameter after installation.

CC. Use cable acceptable for installation as “Open cabling” in spaces used for environmental air handling (plenum) when installed in accordance with NEC Article 300-22.

DD. All Data and Voice wiring shall be terminated in TIA/EIA wiring configuration T-568-B unless Owner/Consultant indicates another termination scheme.

EE. All horizontal cables shall have an installed length less than 90 meters (295ft.).

FF. Communications Outlet Assemblies:

1. Provide quantity to support locations specified on drawings.

2. Verify color with General Contractor/Owner prior to purchase.

3. Acceptable Manufactures: refer to approved manufacturer list.

4. Wall Information Outlet Jacks: refer to approved manufacturer list.

5. Data: Blue Category 6A T-568-B wire scheme 8-pin 8 pos modular jack.

6. Voice (second data): White 6A T-568-B wire scheme 8-pin 8 pos modular jack.

7. Lighting Control (nLight Lighting Control System): Yellow 6A T-568-B wire scheme 8-pin 8 pos modular jack.

8. Lighting Control : Furnish and install Face Plates-Single Gang 2 port faceplates at each power pack. (unless otherwise indicated in the construction documents). - Provide Blank inserts as needed.

9. Face Plates-Single Gang 2 port faceplates (unless otherwise indicated in the construction documents). - Provide Blank inserts as needed.

10. Floor Information Outlets Jacks: refer to approved manufacturer list.

GG. The cable manufacturer shall test, and provide with each 1000ft. spool/box of horizontal cabling, a factory certified test report guaranteeing each spool/box complies with the electrical performance of the specified Category cable.

HH. Modular System Furniture: Contractor shall supply voice and data termination in Modular System Furniture and/or Custom Built Furniture complete with mounting bracket. Refer to architectural drawings for locations and details if applicable.

3.29 HORIZONTAL COPPER DATA TERMINATION

A. Provide Horizontal UTP, Category 6A, 4-pair, #24 AWG, Plenum Rated Cable: Use one manufacturer only to maintain cable/components. Warranty-shall meet or exceed latest EIA/TIA specifications.

B. Provide rack mounted Termination Patch Panel (data); Category 6A Patch Panels. They shall be RJ-45 modular jack to 110-type printed circuit board style patch panels, 48 ports as needed. Furnish units that adhere to the performance requirements of ANSI/TIA/EIA-568-B standards, utilizing the wiring termination scheme T-568-B.

C. Provide rack mounted Termination Patch Panel (camera surveillance camera); Category 6A Patch Panels. They shall be RJ-45 modular jack to 110-type printed circuit board style patch panels,48 ports as needed. Furnish units that adhere to the performance requirements of ANSI/TIA/EIA-568-B standards, utilizing the wiring termination scheme T-568-B.

D. Horizontal Cable: The cable jacket shall be printed with a minimum of the following information: Category specified performance marking, Manufacturer, Manufacturer's part number, cable type, listing file number, number of pairs, listing type (i.e., CMP), and sequential footage markings.

1. Cable shall be UL or ETL listed type CMP, TIA/EIA Category 6 with blue outer jacket for the first work area termination (left most jack) and white for the second cable (right most jack) to the same work area termination. Work areas that have terminations in excess of two cables the contractor shall alternate the cables colors accordingly. Refer to drawings for additional detail.

2. Conductors shall be UTP of a gauge that complies with the Category 6A standard, and have 4 Pairs of solid copper conductors.

3. All Internal conductors insulation composition shall be of Dupont® Teflon FEP Fluoropolymer resin.

4. Color-coding shall match TIA/EIA 568-B standards.

5. Cable shall be listed in the UL or ETL Verified LAN Cable Products Directory. Cable shall meet all tests for current Category 6A specifications.

3.30 HORIZONTAL COPPER VOICE TERMINATION

A. Horizontal Cables for Voice Service: Use Plenum rated UTP cables complying with Category 6A

of EIA/TIA-568-B for runs between MC/TR's and I/O's.

1. Cable shall be UL or ETL listed type CMP, TIA/EIA Category 6A with white (second cable, right most jacks) outer jacket.

2. Conductors shall be UTP of a gauge that complies with the Category 6A standard and have 4 Pairs of solid copper conductors.

3. All Internal conductors insulation composition shall be of Dupont® Teflon FEP Fluoropolymer resin.

4. Color-coding shall match TIA/EIA 568-B standards

5. Cable shall be listed in the UL or ETL Verified LAN Cable Products Directory. Cable shall meet all tests for current Category 6A specifications.

B. Terminate horizontal voice cables into rack mounted 48 port Category 6A patch panels using the T-568Bwiringscheme without damaging twisted pairs or jacket.

C. Wall Mounted Telephone Faceplates: Provide Stainless Steel faceplate with integral 8-pin, 8-position voice jack wired in accordance with the T-568-B wiring designation for the termination of Voice UTP cables specified herein.

D. Provide one voice cable to elevator'(s) voice cabling terminal(s) in this building. Coordinate with elevator installer, and client representative. Consult with General Contractor on location of terminus point and length of cable. Clearly, identify elevator-wiring locations on voice termination hardware in MC/TR's, and on documentation of record. Terminate cable in the last position on the horizontal blocks.

E. An additional 4 pair UTP Category 6A horizontal copper cable may be required for 911 emergency connectivity. Coordinate exact requirements with General Contractor and security consultant/contractor and termination location on site.

F. Contractor shall install one Voice 4-pair Category 6A UTP copper cable for each pay phone (public phone) location. Confirm exact requirements with client and network consultant on a later date. Phone, shelf, booth and furniture provided by others.

3.31 DATA PATCH CORDS

A. Copper: Provide Category 6A data patch cords in lengths and quantities as specified by Owner/consultant. Verify prior to purchase. Category 6A patch cords will be of the same manufacturer as the Category 6A horizontal data cable.

3.32 VOICE PATCH CORDS

A. Patch cords at workstations: Provided by others.

B. Others shall provide voice cross-connection at MC/TR rooms.

3.33 FIBER PATCH CORDS

A. Riser/Backbone: Provide duplex fiber jumpers, "SC/SC". Coordinate exact lengths and quantities with owner/Consultant prior to purchase

3.34 ADMINISTRATION, TESTING, AND IDENTIFICATIONS

A. These specifications will be strictly enforced. The contractor must verify that the requirements of the specifications are fully met through testing, active data throughput, and documentation as specified below. This includes confirmation of requirements by demonstration, testing and inspection. Demonstration shall be provided in final walk-through and in soft and printed test data. If part or all pairs of cable do not meet specifications contained in this document, the cable shall be replaced at contractor's cost.

B. Test Plan: provide a complete and detailed test plan for the cabling system specified herein including a complete list of test equipment for UTP and light guide components and accessories. Include procedures for certification, validation, and testing. Furnish factory reel tests for all cable. Owner will require that the Telecommunications Cabling System installed by the contractor be fully certified to meet all necessary requirements to be compliant with referenced IEEE and EIA/TIA specifications.

C. Testing Agency: Contractor will engage a qualified testing agency to perform field quality control testing. This 'agency' may be Contractor's personnel if the manufacturer of the testing equipment certifies them to conduct the required tests.

D. Correct malfunctioning units at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

E. Contractor will complete all work and documentation according to manufacturer guidelines to insure manufacturer's warranty remains in effect. Contractor shall obtain certificates from manufacturer attesting to warranty being in effect and include certificates with other deliverables due at the completion of the project.

F. Owner reserves the right to be present during any or all of testing.

G. Standards Compliance & Test Requirements: Cabling must meet the indicated performance specifications: TIA/EIA 568-A and TIA/EIA TSB-67 Category 3, TIA 568-A Category 6 or latest.

3.35 DATA AND VOICE TESTING (COPPER)

A. Testers shall be calibrated by factory at factory recommended intervals. Produce documentation to validate compliance.

B. Testers shall be a minimum of a class 2 (level IIe), bi-directional, and Category 6A tester.

C. Testers shall be capable of reporting data at all measured points and uploading the data to a printer PC/Printer.

D. Serial number of tester shall be included with the test results.

E. Test cords shall be new factory manufactured leads.

F. No test leads shall be used for greater than 1,000 tests, or the maximum number of tests recommended by manufacturer. Follow manufacturer's recommendations. Produce documentation on manufacturer's testing procedures and recommendation. Provide documentation on conformance with manufacturer testing procedures.

G. Use test leads/patch cord factory made that are "tuned" to test the particular manufacturer's cabling system used for permanent link tests.

H. Certify that tester's software has been updated within the last 30 days prior to testing

I. Testers shall be capable of testing at a minimum to the following levels at 100 MHz and comparable measures at 250, 350 and 500 MHz:

J. Use only approved UTP/Fiber test equipment: Microtest Omni Scanner, Fluke DSP 400, or

Agilent/HP Wirescope 350 or the latest model.

K. Tester Parameters: Comply with the following table:

A. Testing on all horizontal/riser and inter-building copper cabling shall be of the Permanent Link type. However, Contractor shall warrant performance based on Channel performance and if required provide patch cords that meet channel performance criteria.

B. The permanent link consists of up to 90m (295ft) of horizontal cabling and one connection at each end and may also include an optional/consolidation point connection (CP).

C. All cabling not tested strictly in accordance with these procedures shall be re-tested at no additional cost to the Owner.

D. 100% of the installed cabling must be tested. All tests must pass acceptance criteria defined in applicable EIA/TIA 568-C.2 Category 6A standard.

E. Test equipment shall be fully charged prior to each days testing.

3.37 COPPER VOICE TESTING

A. Copper Cable Procedures: Inspect all cabling for physical damage and test each conductor signal path for continuity, shorts to ground, wire mapping, line loss, and shorts. Test for faulty connector splices, and terminations. Voice cabling rated at Category 6A and Category 6A shall be tested as per data testing specifications.

B. Each pair of Riser copper cable shall be tested for standard wire mapping, continuity, opens, shorts, and grounded pairs. Record and deliver all tests in paper and electronic media.

C. Correct malfunctioning units at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest. Any subsequent failures noted in the retesting of all cable plant shall be corrected as noted above

D. Contractor will complete all work and documentation according to manufacturer guidelines to insure manufacturer's warranty remains in effect. Contractor shall obtain certificates from manufacturer attesting to warranty being in effect and include certificates with other deliverables due at the completion of the project.

3.38 FIBER TESTING, POWER METER AND OTHER REQUIREMENTS

A. Single Mode and Multi Mode Fiber Testing: Shall conform to test procedures, bandwidth, and attenuation measures specified herein and EIA/TIA standards. Contractor shall use a Power Meter and/or OTDR for fiber testing complete with hard and soft copies of test results including dB loss for links. Max loss shall be less than .5dB, unless manufacturer specifications are less. Testing shall be done from each end of fiber link. Contractor shall obtain certificates from manufacturer attesting to warranty being in effect and include certificates with other deliverables due at the completion of the project.

3.39 PATCH CORD TESTING

A. Provided patch cords shall be new, tested to manufacturer specifications listed and come with full manufacturer factory warranty.

3.40 LABELING

A. Label Fiber Optic cable runs with orange or red "Caution – Fiber Optic Cable" tags in Telecommunications Rooms, Pull Boxes, and other visible open space. Refer to approved manufacturers.

B. Label conduit/innerduct intended for fiber optical cabling every 50 feet with "Caution – Fiber Optic Cable" visible and on accessible ceiling space.

C. System: use a unique, four syllable alphanumeric designation for each cable, and label cable, jacks, connectors, and terminals to which it connects with the same designation. The following is an example of such a labeling system:

1. First syllable identifies and locates wiring closet or equipment room and floor where cable originates.

2. Second syllable identifies and locates cross-connect block-column or rack number in which the cable terminates.

3. Third syllable identifies the block or patch panel number.

4. Fourth syllable designates the position occupied by the cable pairs in the field. For example, the patch panel, WIC port number, or BIX termination clock connectors. Refer to drawings for this detail.

D. Label each horizontal cable at four points:

1. General: Label each cable within 4 inches of each termination where it is accessible and readable in a cabinet, junction/splice case, or outlet box, and elsewhere as indicated.

2. Distribution Racks, blocks and other terminating equipment: Label each unit and field within that unit within 4 inches from the block or patch panel termination.

3. Within Connector Fields, in Wiring Closets and Equipment Rooms: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both communication and data-processing equipment, use a different color for jacks and plugs of each service.

4. Cable Schedule: Post in prominent location in each wiring closet and equipment room. List incoming and outgoing cables and their designations, origins, and destinations.

E. Workstation: Label cables within outlet boxes between 8 and 12 inches from I/O termination.

F. Labeling of exposed cables and cables in cable runways/conduits: Three (3) feet after exiting MC or TR room wall; and three (3) feet prior to entering wall of room that cable I/O is located in.

G. Communications room Grounding will be marked conspicuously with permanent plastic labels at each end and location stating “Caution: telecommunication Ground- DO NOT REMOVE”. Indicate the room number of the opposite end of the wire.

H. All copies (printed and electronic) of floor plans shall show outlet locations identified by their unique identifier. Place one copy of all floor plans with I/O’s in each MC/TR room. Coordinate with owner if they require specific requirements, like: lamination and mounting height, etc.

3.41 DOCUMENTATION

A. Test reports must be submitted in hardcopy and electronic format. Hand-written test reports are not acceptable.

1. Hardcopy reports are to be submitted in labeled 3 ring binders with an attached affidavit verifying passing execution of all tests. For large installations, electronic reports with hardcopy summaries are preferred. Hardcopy summary reports shall contain the following information on each row of the report: circuit ID, test specification used, length of cable, date of test, and pass/fail result.

2. Electronic reports are to be submitted on 3.5-inch diskettes or CD-ROM format. If proprietary software is used, disk or CD shall contain any necessary software required to view test results. If the results are delivered in a standard format like Excel, Access, CSV files, etc. then software to read these files are not provided.

Electronic reports must be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate must reference traceable circuit numbers that match the electronic record.

B. Test reports shall include the following information for each cabling element tested:

1. Wiremap results that indicate the cabling has no shorts, opens, miss-wires, split, reversed, or crossed pairs, and end-to-end connectivity is achieved.

2. For Category 6A cabling: Attenuation, NEXT, PSNEXT, ACR, Power Sum ACR, ReturnLoss, ELFEXT, PSELFEXT, Propagation Delay, and Delay Skew data that indicate the worst case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1 MHz to
500 MHz or highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards. Any individual test that fails the relevant performance specification shall be marked as a FAIL.

3. Length (in meters), propagation delay, and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.

4. Cable manufacturer, cable model number/type, and NVP

5. Tester manufacturer, model, serial number, hardware version, and software version.

6. Circuit ID number and project name.

7. Auto test specification used

8. Overall pass/fail indication

9. Date and time of test.

C. Test reports shall be submitted before substantial completion of the project.

3.42 TEST EQUIPMENT

A. Test equipment used under this contract shall be from manufacturers that have a minimum of 5 years experience in producing field test equipment. Manufacturers must be ISO 9001 certified.

B. All test tools of a given type shall be from the same manufacturer, and have compatible electronic results output.

C. The manufacturer of the test equipment must approve test adapter cables. Adapters from other sources are not acceptable.

D. Baseline accuracy of the test equipment must exceed TIA Level IIe (class2), as indicated by independent laboratory testing.

E. Test equipment must be capable of certifying Category 6A, and 6 links/channels.

F. Test equipment must have a dynamic range of at least 100 dB to minimize measurement uncertainty.

G. Test equipment must be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.

H. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.

I. Test equipment must be capable of running individual NEXT, return loss, etc measurements in addition to auto tests. Individual tests increase productivity when diagnosing faults.

J. Test equipment must include a library of cable types, sorted by major manufacturer.

K. Test equipment must store at least 1000 Category 6A auto tests in internal memory.

L. Test equipment must be able to internally group auto tests and cables in project folders for good records management.

M. Test equipment must include DSP technology for support of advanced measurements.

N. Test equipment must make swept frequency measurements in compliance with TIA standards.

O. The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurement.

3.43 SUBSTANTIAL COMPLETION

A. Date for substantial completion: Coordinate with Construction schedule and client's representative at least 3 months in advance for expected communications infrastructure completion date.

3.44 SUPPORT AND WARRANTY

A. Minimum 15-year manufacturer's certified warranty for this specific project shall be submitted in writing with system documentation. Perform installation of cabling system and hardware to insure covering application assurance (workmanship). Contractor shall provide an installation that meets or exceeds the manufacturer requirements and standards for a complete cabling infrastructure.

B. Should the cabling system fail to perform its expected operation within this warranty period due to inferior or faulty material and/or workmanship, the contractor shall promptly make all required corrections without cost to the owner.

3.45 INTERFACES WITH OTHER WORK

A. Weekly Meetings and Progress Reports:

1. Contractor shall have a minimum of one representative attending all weekly-scheduled Construction meetings.

2. Contractor is responsible to present a written documentation of weekly progress and/or delays related to this project to the General contractor and consultant.

3.46 REPAIR/RESTORATION

A. Contractor is responsible for the protection of existing facilities, finishes, and equipment.

B. Contractor is responsible for the patching and repair of facilities, finishes, and equipment as related to the communications installation.

C. Any damage to building or site caused by this contractor, including grass, paving, curbs etc., shall be restored at Contractor's expense to match condition that day or day of quote opening.

D. Provide all supplementary or miscellaneous items, accessories and devices incidental to or necessary for a sound, secure and complete installation, whether or not specifically indicated in the Contract Documents.

E. Contractor shall note and record any other trades related delays to their scope of work and/or safety issues associated to this project.

3.47 LAN EQUIPMENT

A. All active electronic equipment, like Ethernet Switches, WAP controllers, etc. are supplied and installed as specified on plans. Contractor shall have a gold member certified status.

3.48 VOICE SYSTEMS

A. All active voice equipment, are supplied and installed as specified on plans.

3.49 VIDEO AND AUDIO SYSTEMS

A. Furnish and install category 6A cabling systems indicated on drawings for details.

3.50 WAN EQUIPMENT AND TELCO SERVICES

A. Furnish and installed as specified on plans.

3.51 SECURITY ACCESS AND SURVEILLANCE SYSTEMS

A. All Video and Audio equipment, such as conference room multimedia equipment, IP Cameras, Recording equipment etc. are supplied and installed as specified on plans. Refer to documents/drawings for details. Furnish and install categorgy 6A cabling systems as indicated in drawings.

3.52 LIGHTING CONTROL DEVICES -(Network Lighting Controls)

A. Lighting Control cabling: Refer to drawings for details.

END OF SECTION 270000

SECTION 281300 - ACCESS CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Security access central-control station.
2. One or more security access networked workstations.
3. Security access operating system and application software.
4. Security access controllers connected to high-speed electronic-data transmission network.

1.3 DEFINITIONS

A. CCTV: Closed-circuit television.

B. CPU: Central processing unit.

C. Credential: Data assigned to an entity and used to identify that entity.

D. dpi: Dots per inch.

E. DTS: Digital Termination Service. A microwave-based, line-of-sight communication provided directly to the end user.

F. GFI: Ground fault interrupter.

G. Identifier: A credential card; keypad personal identification number; or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.

H. I/O: Input/Output.

I. LAN: Local area network.

J. Location: A Location on the network having a PC-to-controller communications link, with additional controllers at the Location connected to the PC-to-controller link with a TIA 485-A communications loop. Where this term is presented with an initial capital letter, this definition applies.

K. PC: Personal computer. Applies to the central station, workstations, and file servers.

L. PCI Bus: Peripheral Component Interconnect. A peripheral bus providing a high-speed data path between the CPU and the peripheral devices such as a monitor, disk drive, or network.

M. PDF: Portable Document Format. The file format used by the Acrobat document-exchange-system software from Adobe.

N. RAS: Remote access services.

O. RF: Radio frequency.

P. ROM: Read-only memory. ROM data are maintained through losses of power.

Q. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

R. TWAIN: Technology without an Interesting Name. A programming interface that lets a graphics application, such as an image editing program or desktop publishing program, activate a scanner, frame grabber, or other image-capturing device.

S. UPS: Uninterruptible power supply.

T. USB: Universal serial bus.

U. WAN: Wide area network.

V. WAV: The digital audio format used in Microsoft Windows.

W. WMP: Windows media player.

X. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.

Y. Windows: Operating system by Microsoft Corporation.

Z. Workstation: A PC with software that is configured for specific, limited security-system functions.

AA. WYSIWYG: What You See Is What You Get. Text and graphics appear on the screen the same as they will in print.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Reference each product to a location on Drawings. Test and evaluation data presented in Product Data shall comply with SIA BIO-01.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Diagrams for cable management system.

2. System labeling schedules, including electronic copy of labeling schedules that are part of the cable and asset identification system of the software specified in Parts 2 and 3.
3. Wiring Diagrams. For power, signal, and control wiring. Show typical wiring schematics including the following:

    a. Workstation outlets, jacks, and jack assemblies.
    b. Patch cords.
    c. Patch panels.

4. Cable Administration Drawings: As specified in "Identification" Article.
5. Battery and charger calculations for central station, workstations, and controllers.

C. Samples: For workstation outlets, jacks, jack assemblies, and faceplates. For each exposed product and for each color and texture specified.

D. Other Action Submittals:

1. Project planning documents as specified in Part 3.

E. Field quality-control reports.

F. Operation and Maintenance Data: For security system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section include the following:

1. Microsoft Windows software documentation.
2. PC installation and operating documentation, manuals, and software for the PC and all installed peripherals. Software shall include system restore, emergency boot diskettes, and drivers for all installed hardware. Provide separately for each PC.
3. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.
4. System installation and setup guides with data forms to plan and record options and setup decisions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

1. Cable installer must have on staff a registered communication distribution designer certified by Building Industry Consulting Service International.

B. Source Limitations: Obtain central station, workstations, controllers, Identifier readers, and all software through one source from single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70, "National Electrical Code."

E. Comply with SIA DC-01 and SIA DC-03 and SIA DC-07.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Central Station, Workstations, and Controllers:

1. Store in temperature- and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50 and 85 deg F (10 and 30 deg C), and not more than 80 percent relative humidity, noncondensing.
2. Open each container; verify contents against packing list; and file copy of packing list, complete with container identification, for inclusion in operation and maintenance data.
3. Mark packing list with the same designations assigned to materials and equipment for recording in the system labeling schedules that are generated by software specified in "Cable and Asset Management Software" Article.
4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Control Station: Rated for continuous operation in ambient conditions of 60 to 85 deg F (16 to 30 deg C) and a relative humidity of 20 to 80 percent, noncondensing.
2. Indoor, Controlled Environment: NEMA 250, Type 1 enclosure. System components, except the central-station control unit, installed in air-conditioned indoor environments shall be rated for continuous operation in ambient conditions of 36 to 122 deg F (2 to 50 deg C) > dry bulb and 20 to 90 percent relative humidity, noncondensing.
3. Indoor, Uncontrolled Environment: NEMA 250, Type 4 enclosures. System components installed in non-air-conditioned indoor environments shall be rated for continuous operation in ambient conditions of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.
4. Outdoor Environment: NEMA 250, NEMA 250, Type 4-316 stainless steel enclosures. System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h) and snow cover up to 24 inches (610 mm) thick.
5. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
6. Corrosive Environment: For system components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, provide NEMA 250, Type 4-316 stainless steel enclosures.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Alarm Printer Black/Red Ribbons: Package of 12.

2. Laser Printers: Three toner cassettes and one replacement drum unit.
3. Credential card blanks, ready for printing. Include enough credential cards for all personnel to be enrolled at the site plus an extra 50 percent for future use.
4. Fuses of all kinds, power and electronic, equal to 10 percent of amount installed for each size used, but no fewer than three units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. ABM Data Systems, Inc.
2. Alco Advanced Technologies.
3. Bosch Security Systems, Inc.
4. Checkpoint Systems, Inc.
5. Continental Instruments; a NAPCO Security Group company.
6. Deister Electronic USA, Inc.
7. Galaxy Control Systems.
8. General Electric Company; GE Security, Inc.
9. HES; an ASSA ABLOY Group company.
10. Hirsch Electronics Corporation.
11. Honeywell International Inc; Honeywell Access Systems.
12. Honeywell International Inc; Honeywell Integrated Security (formerly: NexWatch).
13. Keyscan.
14. Matrix Systems, Inc.
15. Secura Key.
16. TAC; Andover Continuum Brand.

2.2 DESCRIPTION

A. Security Access System: PC-based central station, one or more networked PC-based workstations, and field-installed controllers, connected by a high-speed electronic-data transmission network.

B. System Software: Based on 64 -bit, windows 7 or windows 8 central-station, workstation operating system, server operating system, and application software. Software shall have the following capabilities:

1. Multiuser and multitasking to allow for independent activities and monitoring to occur simultaneously at different workstations.
2. Graphical user interface to show pull-down menus and a menu-tree format that complies with interface guidelines of Microsoft Windows.
3. System license for the entire system including capability for future additions that are within the indicated system size limits specified in this Section.
4. Open-architecture system that allows importing and exporting of data and interfacing with other systems that are compatible with Microsoft Windows.
5. Password-protected operator login and access.

6. Open-database-connectivity compliant.

C. Network connecting the central station and workstations shall be a LAN using Microsoft Windows-based TCP/IP with a capacity of connecting up to 99 workstations. System shall be portable across multiple communication platforms without changing system software.

D. Network(s) connecting PCs and controllers shall consist of one or more of the following:

1. Local area, IEEE 802.3 Fast Ethernet Gigabit-Ethernet or 100 BASE-TX, star topology network based on TCP/IP.
2. Direct-connected, RS-232 cable from the COM port of the central station to the first controller, then RS-485 cable to interconnect the remaining controllers at that Location.
3. Dial-up and cable modem connection using a standard cable or dial-up telephone line.

2.3 OPERATION

A. Security access system shall use a single database for access-control and credential-creation functions.

B. Distributed Processing: A fully distributed processing system.

1. Access-control information, including time, date, valid codes, access levels, and similar data, shall be downloaded to controllers so each controller can make access-control decisions.
2. Intermediate controllers for access control are prohibited.
3. In the event that communications with the central controller are lost, controllers shall automatically buffer event transactions until communications are restored, at which time buffered events shall be uploaded to the central station.

C. Number of Locations:

1. Support at least 32,000 separate Locations using a single PC with combinations of direct-connect, dial-up, or TCP/IP LAN connections to each Location.
2. Each Location shall have its own database and history in the central station.
3. Locations may be combined to share a common database.

D. Data Capacity:

1. 130 different card-reader formats.
2. 999 comments.
3. 48graphic file types for importing maps.

E. Location Capacity:

1. 128 reader-controlled doors.
2. 50,000 total-access credentials.
3. 2048 supervised alarm inputs.
4. 2048 programmable outputs.
5. 32,000 custom action messages per Location to instruct operator on action required when alarm is received.

F. System Network Requirements:

1. System components shall be interconnected and shall provide automatic communication of status changes, commands, field-initiated interrupts, and other communications required for proper system operation.
2. Communication shall not require operator initiation or response and shall return to normal after partial- or total-network interruption such as power loss or transient upset.
3. System shall automatically annunciate communication failures to the operator and shall identify the communications link that has experienced a partial or total failure.
4. Communications controller may be used as an interface between the central-station display systems and the field device network. Communications controller shall provide functions required to attain the specified network communications performance.

G. Central station shall provide operator interface, interaction, display, control, and dynamic and real-time monitoring. Central station shall control system networks to interconnect all system components, including workstations and field-installed controllers.

H. Field equipment shall include controllers, sensors, and controls.

1. Controllers shall serve as an interface between the central station and sensors and controls.
2. Data exchange between the central station and the controllers shall include down-line transmission of commands, software, and databases to controllers.
3. The up-line data exchange from the controller to the central station shall include status data such as intrusion alarms, status reports, and entry-control records.
4. Controllers are classified as alarm-annunciation or entry-control type.

I. System Response to Alarms:

1. Field device network shall provide a system end-to-end response time of one second(s) or less for every device connected to the system.
2. Alarms shall be annunciated at the central station within one second of the alarm occurring at a controller or at a device controlled by a local controller, and within 100 ms if the alarm occurs at the central station.
3. Alarm and status changes shall be displayed within 100 ms after receipt of data by the central station.
4. All graphics shall be displayed, including graphics-generated map displays, on the console monitor within five seconds of alarm receipt at the security console.
5. This response time shall be maintained during system heavy load.

J. False-Alarm Reduction: The design of the central station and controllers shall contain features to reduce false alarms. Equipment and software shall comply with SIA CP-01.

K. Error Detection:

1. Use a cyclic code method to detect single- and double-bit errors, burst errors of eight bits or fewer, and at least 99 percent of all other multibit and burst errors between controllers and the central station.
2. Interactive or product error-detection codes alone will not be acceptable.
3. A message shall be in error if one bit is received incorrectly.
4. Retransmit messages with detected errors.
5. Allow for an operator-assigned two-digit decimal number to each communications link representing the number of retransmission attempts.

6. Central station shall print a communication failure alarm message when the number of consecutive retransmission attempts equals the assigned quantity.
7. Monitor the frequency of data transmission failure for display and logging.

L. Data Line Supervision: System shall initiate an alarm in response to opening, closing, shorting, or grounding of data transmission lines.

M. Door Hardware Interface:

1. Comply with requirements in Division 08 Sections for door hardware required to be monitored or controlled by the security access system.
2. Electrical characteristics of controllers shall match the signal and power requirements of door hardware.

2.4 APPLICATION SOFTWARE

A. System Software: Based on 64 bit, Microsoft Windows central-station and workstation operating system and application software.

1. Multiuser multitasking shall allow independent activities and monitoring to occur simultaneously at different workstations.
2. Graphical user interface shall show pull-down menus and a menu-tree format.
3. Capability for future additions within the indicated system size limits.
4. Open architecture that allows importing and exporting of data and interfacing with other systems that are compatible with operating system.
5. Password-protected operator login and access.

B. Peer Computer Control Software: Detect a failure of a central computer and cause the other central computer to assume control of all system functions without interruption of operation. Both central computers shall have drivers to support this mode of operation.

C. Application Software: Interface between the alarm annunciation and entry-control controllers to monitor sensors and DTS links, operate displays, report alarms, generate reports, and help train system operators.

1. Reside at the central station, workstations, and controllers as required to perform specified functions.
2. Operate and manage peripheral devices.
3. Manage files for disk I/O, including creating, deleting, and copying files; and automatically maintain a directory of all files, including size and location of each sequential and random-ordered record.
4. Import custom icons into graphics to represent alarms and I/O devices.
5. Globally link I/O so that any I/O can link to any other I/O within the same Location without requiring interaction with the host PC. This operation shall be at the controller.
6. Globally code I/O links so that any access-granted event can link to any I/O with the same Location without requiring interaction with the host PC. This operation shall be at the controller.
7. Messages from PC to controllers and controllers to controllers shall be on a polled network that utilizes check summing and acknowledgment of each message. Communication shall be automatically verified, buffered, and retransmitted if message is not acknowledged.

8. Selectable poll frequency and message time-out settings shall handle bandwidth and latency issues for TCP/IP, RF, and other PC-to-controller communications methods by changing the polling frequency and the amount of time the system waits for a response.
9. Automatic and encrypted backups for database and history backups shall be automatically stored at a selected workstation and encrypted with a nine-character alphanumeric password that must be used to restore or read data contained in backup.
10. Operator audit trail for recording and reporting all changes made to database and system software.
11. Support network protocol and topology, TCP/IP, Novel Netware, Digital Pathworks, Banyan Vines, LAN/WAN, and RAS.

D. Workstation Software:

1. Password levels shall be individually customized at each workstation to allow or disallow operator access to program functions for each Location.
2. Workstation event filtering shall allow user to define events and alarms that will be displayed at each workstation. If an alarm is unacknowledged (not handled by another workstation) for a preset amount of time, the alarm will automatically appear on the filtered workstation.

E. Controller Software:

1. Controllers shall operate as autonomous, intelligent processing units.

    a. Controllers shall make decisions about access control, alarm monitoring, linking functions, and door-locking schedules for their operation, independent of other system components.
    b. Controllers shall be part of a fully distributed processing-control network.
    c. The portion of the database associated with a controller, and consisting of parameters, constraints, and the latest value or status of points connected to that controller, shall be maintained in the controller.

2. The following functions shall be fully implemented and operational within each controller:

    a. Monitoring inputs.
    b. Controlling outputs.
    c. Automatically reporting alarms to the central station.
    d. Reporting of sensor and output status to the central station on request.
    e. Maintaining real time, automatically updated by the central station at least once a day.
    f. Communicating with the central station.
    g. Executing controller resident programs.
    h. Diagnosing.
    i. Downloading and uploading data to and from the central station.

3. Controller Operations at a Location:

    a. Up to 64 controllers connected to TIA 485-A communications loop. Globally operating I/O linking and anti-passback functions between controllers within the same Location without central-station or workstation intervention. Linking and anti-passback shall remain fully functional within the same Location even when the central station or workstations are off-line.

b. In the event of communication failure between the central station and a Location, there shall be no degradation in operations at the controllers at that Location. Controllers at each Location shall be connected to a memory buffer with a capacity to store up to 10,000 events; there shall be no loss of transactions in system history files until the buffer overflows.
c. Buffered events shall be handled in a first-in-first-out mode of operation.

4. Individual Controller Operation:

a. Controllers shall transmit alarms, status changes, and other data to the central station when communications circuits are operable. If communications are not available, controllers shall function in a stand-alone mode; operational data, including the status and alarm data normally transmitted to the central station, shall be stored for later transmission to the central station. Storage capacity for the latest 1024 events shall be provided at each controller.
b. Card-reader ports of a controller shall be custom configurable for at least 120 different card-reader or keypad formats. Multiple reader or keypad formats may be used simultaneously at different controllers or within the same controller.
c. Controllers shall provide a response to card readers or keypad entries in less than 0.25 seconds, regardless of system size.
d. Controllers that are reset, or powered up from a nonpowered state, shall automatically request a parameter download and reboot to their proper working state. This shall happen without any operator intervention.
e. Initial Startup: When controllers are brought on-line, database parameters shall be automatically downloaded to them. After initial download is completed, only database changes shall be downloaded to each controller.
f. On failure for any reason, controllers shall perform an orderly shutdown and force controller outputs to a predetermined failure-mode state, consistent with the failure modes shown and the associated control device.
g. After power is restored, following a power failure, startup software shall initiate self-test diagnostic routines, after which controllers shall resume normal operation.
h. After controller failure, if the database and application software are no longer resident, controllers shall not restart but shall remain in the failure mode until repaired. If database and application programs are resident, controllers shall immediately resume operation. If not, software shall be restored automatically from the central station.

5. Communications Monitoring:

a. System shall monitor and report status of TIA 485-A communications loop of each Location.
b. Communication status window shall display which controllers are currently communicating, a total count of missed polls since midnight, and which controller last missed a poll.
c. Communication status window shall show the type of CPU, the type of I/O board, and the amount of RAM for each controller.

6. Operating systems shall include a real-time clock function that maintains seconds, minutes, hours, day, date, and month. The real-time clock shall be automatically synchronized with the central station at least once a day to plus or minus 10 seconds. The time synchronization shall be automatic, without operator action and without requiring system shutdown.

F. PC-to-Controller Communications:

1. Central-station or workstation communications shall use the following:

   a. Direct connection using serial ports of the PC.
   b. TCP/IP LAN interface cards.
   c. Dial-up or cable modems for connections to Locations.

2. Each serial port used for communications shall be individually configurable for "direct communications," "modem communications incoming and outgoing," or "modem communications incoming only," or as an ASCII output port. Serial ports shall have adjustable data transmission rates and shall be selectable under program control.
3. Use multiport communications board if more than two serial ports are needed.

   a. Use a 4-, 8-, or 16-serial port configuration that is expandable to 32- or 64-serial ports.
   b. Connect the first board to an internal PCI bus adapter card.

4. Direct serial, TCP/IP, and dial-up, cable, or satellite communications shall be alike in the monitoring or control of the system except for the connection that must first be made to a dial-up or voice-over IP Location.
5. TCP/IP network interface card (NIV) shall have an option to set the poll-frequency and message-response time-out settings.
6. PC-to-controller and controller-to-controller communications (direct, dial-up, or TCP/IP) shall use a polled-communication protocol that checks sum and acknowledges each message. All communications in this subparagraph shall be verified and buffered, and retransmitted if not acknowledged.

G. Direct Serial or TCP/IP PC-to-Controller Communications:

1. Communication software on the PC shall supervise the PC-to-controller communications link.
2. Loss of communications to any controller shall result in an alarm at all PCs running the communication software.
3. When communications are restored, all buffered events shall automatically upload to the PC, and any database changes shall be automatically sent to the controller.

H. Dial-up Modem or Cable Modem PC-to-Controller Communications:

1. Communication software on the PC shall supervise the PC-to-controller communications link during dial-up modem connect times.
2. Communication software shall be programmable to routinely poll each of the remote dial-up or cable modem Locations, collecting event logs and verifying phone lines at operator-selectable time intervals for each Location.
3. System shall be programmable for dialing and connecting to all dial-up or cable modem Locations and for retrieving the accrued history transactions on an automatic basis as often as once every 10 minutes and up to once every 9999 minutes.
4. Failure to communicate to a dial-up Location three times in a row shall result in an alarm at the PC.
5. Time offset capabilities shall be present so that Locations in a different geographical time zone than the host PC will be set to, and maintained at, the proper local time. This feature shall allow for geographical time zones that are ahead of or behind the host PC.

6. The controller connected to a dial-up or cable modem shall automatically buffer all normal transactions until its buffer reaches 80 percent of capacity. When the transaction buffer reaches 80 percent, the controller shall automatically initiate a call to the central station and upload all transactions.
7. Alarms shall be reported immediately.
8. Dial-up or cable modems shall be provided by manufacturer of the system. Modems used at the controller shall be powered by the controller. Power to the modem shall include battery backup if the controller is so equipped.

I. Controller-to-Controller Communications:

1. TIA 485-A, four-wire, point-to-point, regenerative (repeater) communications network methodology.
2. TIA 485-A communications signal shall be regenerated at each controller.

J. Database Downloads:

1. All data transmissions from PCs to a Location, and between controllers at a Location, shall include a complete database checksum to check the integrity of the transmission. If the data checksum does not match, a full data download shall be automatically retransmitted.
2. If a controller is reset for any reason, it shall automatically request and receive a database download from the PC. The download shall restore data stored at the controller to their normal working state and shall take place with no operator intervention.
3. Software shall provide for setting downloads via dial-up connection to once per 24-hour period, with time selected by the operator.
4. Software shall provide for setting delays of database downloads for dial-up connections. Delays change the download from immediately to a delay ranging from one to 999 minutes.

K. Operator Interface:

1. Inputs in system shall have two icon representations, one for the normal state and one for the abnormal state.
2. When viewing and controlling inputs, displayed icons shall automatically change to the proper icon to display the current system state in real time. Icons shall also display the input's state, whether armed or bypassed, and if the input is in the armed or bypassed state due to a time zone or a manual command.
3. Outputs in system shall have two icon representations, one for the secure (locked) state and one for the open (unlocked) state.
4. Icons displaying status of the I/O points shall be constantly updated to show their current real-time condition without prompting by the operator.
5. The operator shall be able to scroll the list of I/Os and press the appropriate toolbar button, or right click, to command the system to perform the desired function.
6. Graphic maps or drawings containing inputs, outputs, and override groups shall include the following:

    a. Database to import and store full-color maps or drawings and allow for input, output, and override group icons to be placed on maps.
    b. Maps to provide real-time display animation and allow for control of points assigned to them.
    c. System to allow inputs, outputs, and override groups to be placed on different maps.

d. Software to allow changing the order or priority in which maps will be displayed.

7. Override Groups Containing I/Os:

   a. System shall incorporate override groups that provide the operator with the status and control over user-defined "sets" of I/Os with a single icon.
   b. Icon shall change automatically to show the live summary status of points in that group.
   c. Override group icon shall provide a method to manually control or set to time-zone points in the group.
   d. Override group icon shall allow the expanding of the group to show icons representing the live status for each point in the group, individual control over each point, and the ability to compress the individual icons back into one summary icon.

8. Schedule Overrides of I/Os and Override Groups:

   a. To accommodate temporary schedule changes that do not fall within the holiday parameters, the operator shall have the ability to override schedules individually for each input, output, or override group.
   b. Each schedule shall be composed of a minimum of two dates with separate times for each date.
   c. The first time and date shall be assigned the override state that the point shall advance to when the time and date become current.
   d. The second time and date shall be assigned the state that the point shall return to when the time and date become current.

9. Copy command in database shall allow for like data to be copied and then edited for specific requirements, to reduce redundant data entry.

L. Operator Access Control:

1. Control operator access to system controls through three password-protected operator levels. System operators and managers with appropriate password clearances shall be able to change operator levels for operators.
2. Three successive attempts by an operator to execute functions beyond their defined level during a 24-hour period shall initiate a software tamper alarm.
3. A minimum of 32 passwords shall be available with the system software. System shall display the operator's name or initials in the console's first field. System shall print the operator's name or initials, action, date, and time on the system printer at login and logoff.
4. The password shall not be displayed or printed.
5. Each password shall be definable and assignable for the following:

   a. Selected commands to be usable.
   b. Access to system software.
   c. Access to application software.
   d. Individual zones that are to be accessed.
   e. Access to database.

M. Operator Commands:

1. Command Input: Plain-language words and acronyms shall allow operators to use the system without extensive training or data-processing backgrounds. System prompts shall be a word, a phrase, or an acronym.
2. Command inputs shall be acknowledged and processing shall start in not less than one second(s).
3. Tasks that are executed by operator's commands shall include the following:

    a. Acknowledge Alarms: Used to acknowledge that the operator has observed the alarm message.
    b. Place Zone in Access: Used to remotely disable intrusion-alarm circuits emanating from a specific zone. System shall be structured so that console operator cannot disable tamper circuits.
    c. Place Zone in Secure: Used to remotely activate intrusion-alarm circuits emanating from a specific zone.
    d. System Test: Allows the operator to initiate a system-wide operational test.
    e. Zone Test: Allows the operator to initiate an operational test for a specific zone.
    f. Print reports.
    g. Change Operator: Used for changing operators.
    h. Security Lighting Controls: Allows the operator to remotely turn on or turn off security lights.
    i. Display Graphics: Used to show any graphic displays implemented in the system. Graphic displays shall be completed within 20 seconds from time of operator command.
    j. Run system tests.
    k. Generate and format reports.
    l. Request help with the system operation.

        1) Include in main menus.
        2) Provide unique, descriptive, context-sensitive help for selections and functions with the press of one function key.
        3) Provide navigation to specific topic from within the first help window.
        4) Help shall be accessible outside the application program.

    m. Entry-Control Commands:

        1) Lock (secure) or unlock (open) each controlled entry and exit up to four times a day through time-zone programming.
        2) Arm or disarm each monitored input up to four times a day through time-zone programming.
        3) Enable or disable readers or keypads up to two times a day through time-zone programming.
        4) Enable or disable cards or codes up to four times a day per entry point through access-level programming.

4. Command Input Errors: Show operator input assistance when a command cannot be executed because of operator input errors. Assistance screen shall use plain-language words and phrases to explain why the command cannot be executed. Error responses that require an operator to look up a code in a manual or other document are not acceptable. Conditions causing operator assistance messages include the following:

    a. Command entered is incorrect or incomplete.
    b. Operator is restricted from using that command.
    c. Command addresses a point that is disabled or out of service.

d. Command addresses a point that does not exist.
e. Command is outside the system's capacity.

N. Alarms:

1. System Setup:

a. Assign manual and automatic responses to incoming-point status change or alarms.
b. Automatically respond to input with a link to other inputs, outputs, or operator-response plans; unique sound with use of WAV files; and maps or images that graphically represent the point location.
c. Sixty-character message field for each alarm.
d. Operator-response-action messages shall allow message length of at least 65,000 characters, with database storage capacity of up to 32,000 messages. Setup shall assign messages to access point, zone, and alarm .
e. Secondary messages shall be assignable by the operator for printing to provide further information and shall be editable by the operator.
f. Allow 25 secondary messages with a field of four lines of 60 characters each.
g. Store the most recent 1000 alarms for recall by the operator using the report generator.

2. Software Tamper:

a. Annunciate a tamper alarm when unauthorized changes to system database files are attempted. Three consecutive unsuccessful attempts to log onto system shall generate a software tamper alarm.
b. Annunciate a software tamper alarm when an operator or other individual makes three consecutive unsuccessful attempts to invoke functions beyond the authorization level.
c. Maintain a transcript file of the last 5000 commands entered at each central station to serve as an audit trail. System shall not allow write access to system transcript files by any person, regardless of their authorization level.
d. Allow only acknowledgment of software tamper alarms.

3. Read access to system transcript files shall be reserved for operators with the highest password authorization level available in system.
4. Animated Response Graphics: Highlight alarms with flashing icons on graphic maps; display and constantly update the current status of alarm inputs and outputs in real time through animated icons.
5. Multimedia Alarm Annunciation: WAV files to be associated with alarm events for audio annunciation or instructions.
6. Alarm Handling: Each input may be configured so that an alarm cannot be cleared unless it has returned to normal, with options of requiring the operator to enter a comment about disposition of alarm. Allow operator to silence alarm sound when alarm is acknowledged.
7. Alarm Automation Interface: High-level interface to central-station alarm automation software systems. Allows input alarms to be passed to and handled by automation systems in the same manner as burglar alarms, using a TIA 232-F ASCII interface.
8. CCTV Alarm Interface: Allow commands to be sent to CCTV systems during alarms (or input change of state) through serial ports.
9. Camera Control: Provides operator ability to select and control cameras from graphic maps.

O. Alarm Monitoring: Monitor sensors, controllers, and DTS circuits and notify operators of an alarm condition. Display higher-priority alarms first and, within alarm priorities, display the oldest unacknowledged alarm first. Operator acknowledgment of one alarm shall not be considered acknowledgment of other alarms nor shall it inhibit reporting of subsequent alarms.

1. Displayed alarm data shall include type of alarm, location of alarm, and secondary alarm messages.
2. Printed alarm data shall include type of alarm, location of alarm, date and time (to nearest second) of occurrence, and operator responses.
3. Maps shall automatically display the alarm condition for each input assigned to that map if that option is selected for that input location.
4. Alarms initiate a status of "pending" and require the following two handling steps by operators:

    a. First Operator Step: "Acknowledged." This action shall silence sounds associated with the alarm. The alarm remains in the system "Acknowledged" but "Un-Resolved."
    b. Second Operator Step: Operators enter the resolution or operator comment, giving the disposition of the alarm event. The alarm shall then clear.

5. Each workstation shall display the total pending alarms and total unresolved alarms.
6. Each alarm point shall be programmable to disallow the resolution of alarms until the alarm point has returned to its normal state.
7. Alarms shall transmit to the central station in real time except for allowing connection time for dial-up locations.
8. Alarms shall be displayed and managed from a minimum of four different windows.

    a. Input Status Window: Overlay status icon with a large red blinking icon. Selecting the icon will acknowledge the alarm.
    b. History Log Transaction Window: Display name, time, and date in red text. Selecting red text will acknowledge the alarm.
    c. Alarm Log Transaction Window: Display name, time, and date in red. Selecting red text will acknowledge the alarm.
    d. Graphic Map Display: Display a steady colored icon representing each alarm input location. Change icon to flashing red when the alarm occurs. Change icon from flashing red to steady red when the alarm is acknowledged.

9. Once an alarm is acknowledged, the operator shall be prompted to enter comments about the nature of the alarm and actions taken. Operator's comments may be manually entered or selected from a programmed predefined list, or a combination of both.
10. For locations where there are regular alarm occurrences, provide programmed comments. Selecting that comment shall clear the alarm.
11. The time and name of the operator who acknowledged and resolved the alarm shall be recorded in the database.
12. Identical alarms from the same alarm point shall be acknowledged at the same time the operator acknowledges the first alarm. Identical alarms shall be resolved when the first alarm is resolved.
13. Alarm functions shall have priority over downloading, retrieving, and updating database from workstations and controllers.
14. When a reader-controlled output (relay) is opened, the corresponding alarm point shall be automatically bypassed.

P. Monitor Display: Display text and graphic maps that include zone status integrated into the display. Colors are used for the various components and current data. Colors shall be uniform throughout the system.

1. Color Code:

a. FLASHING RED: Alerts operator that a zone has gone into an alarm or that primary power has failed.
b. STEADY RED: Alerts operator that a zone is in alarm and alarm has been acknowledged.
c. YELLOW: Advises operator that a zone is in access.
d. GREEN: Indicates that a zone is secure and that power is on.

2. Graphics:

a. Support 32,000 graphic display maps and allow import of maps from a minimum of 16 standard formats from another drawing or graphics program.
b. Allow I/O to be placed on graphic maps by the drag-and-drop method.
c. Operators shall be able to view the inputs, outputs, and the point's name by moving the mouse cursor over the point on the graphic map.
d. Inputs or outputs may be placed on multiple graphic maps. The operator shall be able to toggle to view graphic maps associated with I/Os.
e. Each graphic map shall have a display-order sequence number associated with it to provide a predetermined order when toggled to different views.
f. Camera icons shall have the ability to be placed on graphic maps that, when selected by an operator, will open a video window, display the camera associated with that icon, and provide pan-tilt-zoom control.
g. Input, output, or camera placed on a map shall allow the ability to arm or bypass an input, open or secure an output, or control the pan-tilt-zoom function of the selected camera.

Q. System test software enables operators to initiate a test of the entire system or of a particular portion of the system.

1. Test Report: The results of each test shall be stored for future display or printout. The report shall document the operational status of system components.

R. Report-Generator Software: Include commands to generate reports for displaying, printing, and storing on disk and tape. Reports shall be stored by type, date, and time. Report printing shall be the lowest-priority activity. Report-generation mode shall be operator selectable but set up initially as periodic, automatic, or on request. Include time and date printed and the name of operator generating the report. Report formats may be configured by operators.

1. Automatic Printing: Setup shall specify, modify, or inhibit the report to be generated; the time the initial report is to be generated; the time interval between reports; the end of the period; and the default printer.
2. Printing on Request: An operator may request a printout of any report.
3. Alarm Reports: Reporting shall be automatic as initially set up. Include alarms recorded by system over the selected time and information about the type of alarm (such as door alarm, intrusion alarm, tamper alarm, etc.), the type of sensor, the location, the time, and the action taken.
4. Access and Secure Reports: Document zones placed in access, the time placed in access, and the time placed in secure mode.

5. Custom Reports: Reports tailored to exact requirements of who, what, when, and where. As an option, custom report formats may be stored for future printing.
6. Automatic History Reports: Named, saved, and scheduled for automatic generation.
7. Cardholder Reports: Include data, or selected parts of the data, as well as the ability to be sorted by name, card number, imprinted number, or by any of the user-defined fields.
8. Cardholder by Reader Reports: Based on who has access to a specific reader or group of readers by selecting the readers from a list.
9. Cardholder by Access-Level Reports: Display everyone that has been assigned to the specified access level.
10. Who Is "In" (Muster) Report:

    a. Emergency Muster Report: One-click operation on toolbar launches report.
    b. Cardholder Report. Contain a count of persons who are "In" at a selected Location and a detailed listing of name, date, and time of last use, sorted by the last reader used or by the group assignment.

11. Panel Labels Reports: Printout of control-panel field documentation including the actual location of equipment, programming parameters, and wiring identification. Maintain system installation data within system database so that data are available on-site at all times.
12. Activity and Alarm On-Line Printing: Activity printers for use at workstations; prints all events, or alarms only.
13. History Reports: Custom reports that allow the operator to select any date, time, event type, device, output, input, operator, Location, name, or cardholder to be included or excluded from the report.

    a. Initially store history on the hard disk of the host PC.
    b. Permit viewing of the history on workstations or print history to any system printer.
    c. The report shall be definable by a range of dates and times with the ability to have a daily start and stop time over a given date range.
    d. Each report shall depict the date, time, event type, event description, and device; or I/O name, cardholder group assignment, and cardholder name or code number.
    e. Each line of a printed report shall be numbered to ensure that the integrity of the report has not been compromised.
    f. Total number of lines of the report shall be given at the end of the report. If the report is run for a single event such as "Alarms," the total shall reflect how many alarms occurred during that period.

14. Reports shall have the following four options:

    a. View on screen.
    b. Print to system printer. Include automatic print spooling and "Print To" options if more than one printer is connected to the system.
    c. "Save to File" with full path statement.
    d. System shall have the ability to produce a report indicating status of system inputs and outputs or of inputs and outputs that are abnormal, out of time zone, manually overridden, not reporting, or in alarm.

15. Custom Code List Subroutine: Allow the access codes of system to be sorted and printed according to the following criteria:

    a. Active, inactive, or future activate or deactivate.
    b. Code number, name, or imprinted card number.

c. Group, Location access levels.
d. Start and stop code range.
e. Codes that have not been used since a selectable number of days.
f. In, out, or either status.
g. Codes with trace designation.

16. The reports of system database shall allow options so that every data field may be printed.
17. The reports of system database shall be constructed so that the actual position of the printed data shall closely match the position of the data on the data-entry windows.

S. Anti-Passback:

1. System shall have global and local anti-passback features, selectable by Location. System shall support hard and soft anti-passback.
2. Hard Anti-Passback: Once a credential holder is granted access through a reader with one type of designation (IN or OUT), the credential holder may not pass through that type of reader designation until the credential holder passes through a reader of opposite designation.
3. Soft Anti-Passback: Should a violation of the proper IN or OUT sequence occur, access shall be granted, but a unique alarm shall be transmitted to the control station, reporting the credential holder and the door involved in the violation. A separate report may be run on this event.
4. Timed Anti-Passback: A controller capability that prevents an access code from being used twice at the same device (door) within a user-defined amount of time.
5. Provide four separate zones per Location that can operate without requiring interaction with the host PC (done at controller). Each reader shall be assignable to one or all four anti-passback zones. In addition, each anti-passback reader can be further designated as "Hard," "Soft," or "Timed" in each of the four anti-passback zones. The four anti-passback zones shall operate independently.
6. The anti-passback schemes shall be definable for each individual door.
7. The Master Access Level shall override anti-passback.
8. System shall have the ability to forgive (or reset) an individual credential holder or the entire credential-holder population anti-passback status to a neutral status.

T. Visitor Assignment:

1. Provide for and allow an operator to be restricted to only working with visitors. The visitor badging subsystem shall assign credentials and enroll visitors. Allow only those access levels that have been designated as approved for visitors.
2. Provide an automated log of visitor name, time and doors accessed, and name of person contacted.
3. Allow a visitor designation to be assigned to a credential holder.
4. Security access system shall be able to restrict the access levels that may be assigned to credentials issued to visitors.
5. Allow operator to recall visitors' credential-holder file once a visitor is enrolled in the system.
6. The operator may designate any reader as one that deactivates the credential after use at that reader. The history log shall show the return of the credential.
7. System shall have the ability to use the visitor designation in searches and reports. Reports shall be able to print all or any visitor activity.

U. Time and Attendance:

1. Time and attendance reporting shall be provided to match IN and OUT reads and display cumulative time in for each day and cumulative time in for length designated in the report.
2. Shall be provided to match IN and OUT reads and display cumulative time in for each day and cumulative time in for length designated in the report.
3. System software setup shall allow designation of selected access-control readers as time and attendance hardware to gather the clock-in and clock-out times of the users at these readers.

    a. Reports shall show in and out times for each day, total time in for each day, and a total time in for period specified by the user.
    b. Allow the operator to view and print the reports, or save the reports to a file.
    c. Alphabetically sort reports on the person's last name, by Location or location group. Include all credential holders or optionally select individual credential holders for the report.

V. Training Software: Enables operators to practice system operation, including alarm acknowledgment, alarm assessment, response force deployment, and response force communications. System shall continue normal operation during training exercises and shall terminate exercises when an alarm signal is received at the console.

W. Entry-Control Enrollment Software: Database management functions that allow operators to add, delete, and modify access data as needed.

1. The enrollment station shall not have alarm response or acknowledgment functions.
2. Provide multiple, password-protected access levels. Database management and modification functions shall require a higher operator access level than personnel enrollment functions.
3. The program shall provide means to disable the enrollment station when it is unattended, to prevent unauthorized use.
4. The program shall provide a method to enter personnel identifying information into the entry-control database files through enrollment stations. In the case of personnel identity-verification subsystems, this shall include biometric data. Allow entry of personnel identifying information into the system database using menu selections and data fields. The data field names shall be customized during setup to suit user and site needs. Personnel identity-verification subsystems selected for use with the system shall fully support the enrollment function and shall be compatible with the entry-control database files.
5. Cardholder Data: Provide 99 user-defined fields. System shall have the ability to run searches and reports using any combination of these fields. Each user-defined field shall be configurable, using any combination of the following features:

    a. MASK: Determines a specific format with which data must comply.
    b. REQUIRED: Operator is required to enter data into field before saving.
    c. UNIQUE: Data entered must be unique.
    d. DEACTIVATE DATE: Data entered will be evaluated as an additional deactivate date for all cards assigned to this cardholder.
    e. NAME ID: Data entered will be considered a unique ID for the cardholder.

6. Personnel Search Engine: A report generator with capabilities such as search by last name, first name, group, or any predetermined user-defined data field; by codes not used in definable number of days; by skills; or by seven other methods.
7. Multiple Deactivate Dates for Cards: User-defined fields to be configured as additional stop dates to deactivate any cards assigned to the cardholder.

8. Batch card printing.
9. Default card data can be programmed to speed data entry for sites where most card data are similar.
10. Enhanced ASCII File Import Utility: Allows the importing of cardholder data and images.
11. Card Expire Function: Allows readers to be configured to deactivate cards when a card is used at selected devices.

2.5 SYSTEM DATABASE

A. Database and database management software shall define and modify each point in database using operator commands. Definition shall include parameters and constraints associated with each system device.

B. Database Operations:

1. System data management shall be in a hierarchical menu-tree format, with navigation through expandable menu branches and manipulated with use of menus and icons in a main menu and system toolbar.
2. Navigational Aids:

    a. Toolbar icons for add, delete, copy, print, capture image, activate, deactivate, and muster report.
    b. Point and click feature to facilitate data manipulation.
    c. Next and previous command buttons visible when editing database fields to facilitate navigation from one record to the next.
    d. Copy command and copy tool in the toolbar to copy data from one record to create a new similar record.

3. Data entry shall be automatically checked for duplicate and illegal data and shall be verified for valid format.
4. System shall generate a memo or note field for each item that is stored in database, allowing the storing of information about any defining characteristics of the item. Memo field is used for noting the purpose for which the item was entered, reasons for changes that were made, and the like.

C. File Management:

1. File management shall include database backup and restoration system, allowing selection of storage media, including 3.5-inch floppy disk, Zip and Jaz drives, and designated network resources.
2. Operations shall be both manual and automatic modes. The number of automatic sequential backups before the oldest backup will be overwritten; FIFO mode shall be operator selectable.
3. Backup program shall provide manual operation from any PC on the LAN and shall operate while system remains operational.

D. Operator Passwords:

1. Support up to 32,000 individual system operators, each with a unique password.
2. One to eight alphanumeric characters.
3. Allow passwords to be case sensitive.

4. Passwords shall not be displayed when entered.
5. Passwords shall have unique and customizable password profile, and allow several operators to share a password profile. Include the following features in the password profile:

    a. Predetermine the highest-level password profile for access to all functions and areas of program.
    b. Allow or disallow operator access to any program operation, including the functions of View, Add, Edit, and Delete.
    c. Restrict doors to which an operator can assign access.

6. Operators shall use a user name and password to log on to system. This user name and password shall be used to access database areas and programs as determined by the associated profile.
7. Make provision to allow the operator to log off without fully exiting program. User may be logged off but program will remain running while displaying the login window for the next operator.

E. Access Card/Code Operation and Management: Access authorization shall be by card, by a manually entered code (PIN), or by a combination of both (card plus PIN).

1. Access authorization shall verify the facility code first, the card or card-and-PIN validation second, and the access level (time of day, day of week, date), anti-passback status, and number of uses last.
2. Use data-entry windows to view, edit, and issue access levels. Access-authorization entry-management system shall maintain and coordinate all access levels to prevent duplication or the incorrect creation of levels.
3. Allow assignment of multiple cards/codes to a cardholder.
4. Allow assignment of up to four access levels for each Location to a cardholder. Each access level may contain any combination of doors.
5. Each door may be assigned four time zones.
6. Access codes may be up to 11 digits in length.
7. Software shall allow the grouping of locations so cardholder data can be shared by all locations in the group.
8. Visitor Access: Issue a visitor badge for data tracking or photo ID purposes without assigning that person a card or code.
9. Cardholder Tracing: Allow for selection of cardholder for tracing. Make a special audible and visible annunciation at control station when a selected card or code is used at a designated code reader. Annunciation shall include an automatic display of the cardholder image.
10. Allow each cardholder to be given either an unlimited number of uses or a number from one to 9999 that regulates the number of times the card can be used before it is automatically deactivated.
11. Provide for cards and codes to be activated and deactivated manually or automatically by date. Provide for multiple deactivate dates to be preprogrammed.

F. Security Access Integration:

1. Photo ID badging and photo verification shall use the same database as the security access and may query data from cardholder, group, and other personal information to build a custom ID badge.
2. Automatic or manual image recall and manual access based on photo verification shall also be a means of access verification and entry.

3. System shall allow sorting of cardholders together by group or other characteristic for a fast and efficient method of reporting on, and enabling or disabling, cards or codes.

G. Key control and tracking shall be an integrated function of cardholder data.

1. Provide the ability to store information about which conventional metal keys are issued and to whom, along with key construction information.
2. Reports shall be designed to list everyone who possesses a specified key.

H. Facility Codes: System shall accommodate up to 2048 facility codes per Location, with the option of allowing facility codes to work at all doors or only at particular doors.

I. Operator Comments:

1. With the press of one appropriate button on the toolbar, the user shall be permitted to enter operator comments into the history at any time.
2. Automatic prompting of operator comment shall occur before the resolution of each alarm.
3. Operator comments shall be recorded by time, date, and operator number.
4. Comments shall be sorted and viewed through reports and history.
5. The operator may enter comments in two ways; either or both may be used:

    a. Manually entered through keyboard data entry (typed), up to 65,000 characters per each alarm.
    b. Predefined and stored in database for retrieval on request.

6. System shall have a minimum of 999 predefined operator comments with up to 30 characters per comment.

J. Group:

1. Group names may be used to sort cardholders into groups that allow the operator to determine the tenant, vendor, contractor, department, division, or any other designation of a group to which the person belongs.
2. System software shall have the capacity to assign one of 32,000 group names to an access authorization.
3. Make provision in software to deactivate and reactivate all access authorizations assigned to a particular group.
4. Allow sorting of history reports and code list printouts by group name.

K. Time Zones:

1. Each zone consists of a start and stop time for seven days of the week and three holiday schedules. A time zone is assigned to inputs, outputs, or access levels to determine when an input shall automatically arm or disarm, when an output automatically opens or secures, or when access authorization assigned to an access level will be denied or granted.
2. Up to four time zones may be assigned to inputs and outputs to allow up to four arm or disarm periods per day or four lock or unlock periods per day; up to three holiday override schedules may be assigned to a time zone.
3. Data-entry window shall display a dynamically linked bar graph showing active and inactive times for each day and holiday, as start and stop times are entered or edited.

4. System shall have the capacity for 2048 time zones for each Location.

L. Holidays:

1. Three different holiday schedules may be assigned to a time zone. Holiday schedule consists of date in format MM/DD/YYYY and a description. When the holiday date matches the current date of the time zone, the holiday schedule replaces the time-zone schedule for that 24-hour period.
2. System shall have the capacity for 32,000 holidays.
3. Three separate holiday schedules may be applied to a time zone.
4. Holidays have an option to be designated as occurring on the designated date each year. These holidays remain in the system and will not be purged.
5. Holidays not designated to occur each year shall be automatically purged from the database after the date expires.

M. Access Levels:

1. System shall allow for the creation of up to 32,000 access levels.
2. One level shall be predefined as the Master Access Level. The Master Access Level shall work at all doors at all times and override any anti-passback.
3. System shall allow for access to be restricted to any area by reader and by time. Access levels shall determine when and where an Identifier is authorized.
4. System shall be able to create multiple door and time-zone combinations under the same access level so that an Identifier may be valid during different time periods at different readers even if the readers are on the same controller.

N. User-Defined Fields:

1. System shall provide a minimum of 99 user-defined fields, each with up to 50 characters, for specific information about each credential holder.
2. System shall accommodate a title for each field; field length shall be 20 characters.
3. A "Required" option may be applied to each user-defined field that, when selected, forces the operator to enter data in the user-defined field before the credential can be saved.
4. A "Unique" option may be applied to each user-defined field that, when selected, will not allow duplicate data from different credential holders to be entered.
5. Data format option may be assigned to each user-defined field that will require the data to be entered with certain character types in specific spots in the field entry window.
6. A user-defined field, if selected, will define the field as a deactivate date. The selection shall automatically cause the data to be formatted with the windows MM/DD/YYYY date format. The credential of the holder will be deactivated on that date.
7. A search function shall allow any one user-defined field or combination of user-defined fields to be searched to find the appropriate cardholder. The search function shall include a search for a character string.
8. System shall have the ability to print cardholders based on and organized by the user-defined fields.

O. Code Tracing:

1. System shall perform code tracing selectable by cardholder and by reader.
2. Any code may be designated as a "traced code" with no limit to how many codes can be traced.
3. Any reader may be designated as a "trace reader" with no limit to which or how many readers can be used for code tracing.

4. When a traced code is used at a trace reader, the access-granted message that usually appears on the monitor window of the central station shall be highlighted with a different color than regular messages. A short singular beep shall occur at the same time the highlighted message is displayed on the window.
5. The traced cardholder image (if image exists) shall appear on workstations when used at a trace reader.

2.6 SURGE AND TAMPER PROTECTION

A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor-entry connection to components.

Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Division 26 Section “Transient-voltage suppression for low-voltage electrical power circuits

1. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Division 26 Transient-Voltage Suppression For Low-Voltage Electrical Power Circuits as recommended by manufacturer for type of line being protected.

B. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station control-unit alarm display shall identify tamper alarms and indicate locations.

2.7 CENTRAL-STATION HARDWARE

A. Central-Station Computer: Standard unmodified PC of modular design. The CPU word size shall be 64 bytes or larger; the CPU operating speed shall be at least 3.2 GHz.

1. Memory: 8 Gigabytes of usable installed memory, expandable to a minimum of 16 Gigabytes without additional chassis or power supplies.
2. Power Supply: Minimum capacity of 250 W.
3. Real-Time Clock:

    a. Accuracy: Plus or minus one minute per month.
    b. Time-Keeping Format: 24-hour time format including seconds, minutes, hours, date, day, and month; resettable by software.
    c. Clock shall function for one year without power.
    d. Provide automatic time correction once every 24 hours by synchronizing clock with the Time Service Department of the U.S. Naval Observatory.

4. Serial Ports: Provide two TIA 232-F serial ports for general use, with additional ports as required. Data transmission rates shall be selectable under program control.
5. Parallel Port: An enhanced parallel port.
6. LAN Adapter Card: 10/100 Mbps PCI bus, internal network interface card.
7. Sound Card: For playback and recording of digital WAV sound files that are associated with audible warning and alarm functions.

8. Color Monitor: Not less than 24 inches widescreen LED backlit, with a minimum 10M:1 Dynamic aspect ratio and 1920x1080 resolution. The video card shall be MSI Nvidia GeForce GT610 2GB GDDR3.
9. Keyboard: With a minimum of 64 characters, standard ASCII character set based on ANSI INCITS 154.
10. Mouse: Standard, compatible with the installed software.
11. Special-function keyboard attachments or special-function keys to facilitate data input of the following operator tasks:

    a. Help.
    b. Alarm Acknowledge.
    c. Place Zone in Access.
    d. Place Zone in Secure.
    e. System Test.
    f. Print Reports.
    g. Change Operator.

12. Storage shall include the following, each with appropriate controller:

    a. Minimum 1 TB Solid States.

13. Modem: 56,600 bps, full duplex for asynchronous communications. With error detection, auto answer/autodial, and call-in-progress detection. Modem shall comply with requirements in ITU-T V.34, ITU-T V.42 for error correction, and ITU-T V.42 BIS for data compression standards; and shall be suitable for operating on unconditioned voice-grade telephone lines complying with 47 CFR 68.
14. Audible Alarm: Manufacturer's standard.
15. CD-ROM Drive:

    a. Nominal storage capacity of 650 MB.
    b. Data Transfer Rate: 1.2 Mbps.
    c. Average Access Time: 150 ms.
    d. Cache Memory: 512 KB.
    e. Data Throughput: 1 MB/second, minimum.

16. Dot Matrix Alarm Printer:

    a. Connected to the central station.
    b. Minimum of 96 characters, standard ASCII character set based on ANSI INCITS 154, and with graphics capability and programmable top-of-form control.
    c. Prints in both red and black without ribbon change.
    d. Adjustable sprockets for paper width up to 11 inches.
    e. 80 columns per line, minimum speed of 200 characters per second.
    f. Character Spacing: Selectable at 10, 12, or 17 characters per inch.
    g. Paper: Sprocket-fed fan fold paper.

17. Report Printer:

    a. Connected to the central station and designated workstations.
    b. Laser printer with minimum resolution of 600 dpi.
    c. RAM: 256 MB, minimum.
    d. Printing Speed: Minimum 12 pages per minute.

e. Paper Handling: Automatic sheet feeder with 250 -sheet paper cassette and with automatic feed.

18. Interface: Bidirectional parallel, and universal serial bus.
19. LAN Adapter Card: 10/100 Mbps internal network interface card.

B. Redundant Central Computer: One identical redundant central computer, connected in a hot standby, peer configuration. This computer shall automatically maintain its own copies of system software, application software, and data files. System transactions and other activities that alter system data files shall be updated to system files of redundant computer in near real time. If central computer fails, redundant computer shall assume control immediately and automatically.

C. UPS: Self-contained; Uninterruptible Power Supply."

1. Size: Provide a minimum of six hours of operation of the central-station equipment, including two hours of alarm printer operation.
2. Batteries: Sealed, valve regulated, recombinant, lead calcium.
3. Accessories:

a. Transient voltage suppression.
b. Input-harmonics reduction.
c. Rectifier/charger.
d. Battery disconnect device.
e. Static bypass transfer switch.
f. Internal maintenance bypass/isolation switch.
g. External maintenance bypass/isolation switch.
h. Output isolation transformer.
i. Remote UPS monitoring.
j. Battery monitoring.
k. Remote battery monitoring.

2.8 STANDARD WORKSTATION HARDWARE

A. Workstation shall consist of a standard unmodified PC with accessories and peripherals that configure the workstation for a specific duty.

B. Workstation Computer: Standard unmodified PC of modular design. The CPU word size shall be 64 bytes or larger; the CPU operating speed shall be at least 3.2 GHz.

1. Memory: 8 GB of usable installed memory, expandable to a minimum of 16 GB without additional chassis or power supplies.
2. Power Supply: Minimum capacity of 250 W.
3. Real-Time Clock:

a. Accuracy: Plus or minus one minute per month.
b. Time-Keeping Format: 24-hour time format including seconds, minutes, hours, date, day, and month; resettable by software.
c. Provide automatic time correction once every 24 hours by synchronizing clock with the central station.

4. Serial Ports: Provide two TIA 232-F USB serial ports for general use, with additional ports as required. Data transmission rates shall be selectable under program control.
5. Parallel Port: An enhanced parallel port.
6. Sound Card: For playback and recording of digital WMP sound files that are associated with audible warning and alarm functions.
7. Color Monitor: Not less than 24 inches widescreen LED backlit, with a minimum 10M:1 Dynamic aspect ratio and 1920x1080 resolution. The video card shall be MSI Nvidia GeForce GT610 2GB GDDR3.
8. Keyboard: With a minimum of 64 characters, standard ASCII character set based on ANSI INCITS 154.
9. Mouse: Standard, compatible with the installed software. Minimum resolution shall be 400 dpi.
10. Disk storage shall include the following, each with appropriate controller:

    a. Minimum 1 TB hard solid state

11. CD-ROM/CD-RW Drive:

    a. Nominal Storage Capacity: 700 MB.
    b. Data Transfer Rate: 3.6 Mbps.
    c. Average Access Time: 150 ms.
    d. Cache Memory: 512 KB.
    e. Data Throughput: 3.6 MB/second, minimum.
    f. Read Speed: 48x.
    g. Write Speed: 32x.

12. DVD/DVD-RW Drive:

    a. Nominal Storage Capacity: 4.7 GB.
    b. Data Transfer Rate: 3.6 Mbps.
    c. Cache Memory: 512 KB.
    d. Read Speed: 24x.
    e. Write Speed: 6x.

13. Printer:

    a. Connected to the central station and designated workstations.
    b. Laser printer with minimum resolution of 600 dpi.
    c. RAM: 8 MB, minimum.
    d. Printing Speed: Minimum 12 pages per minute.
    e. Paper Handling: Automatic sheet feeder with 250 -sheet paper cassette and with automatic feed.

14. Interface: Bidirectional parallel, and universal serial bus.
15. LAN Adapter Card: 10/100 Mbps internal network interface card.

C. Redundant Workstation: One identical redundant workstation, connected in a hot standby, peer configuration. This workstation shall automatically maintain its own copies of system software, application software, and data files. System transactions and other activities that alter system data files shall be updated to system files of redundant workstation in near real time. If its associated workstation fails, redundant workstation shall assume control immediately and automatically.

D. UPS: Self-contained, complying with requirements in Division 26 Section "Static Uninterruptible Power Supply."

1. Size: Provide a minimum of six hours of operation of the central-station equipment, including two hours of alarm printer operation.
2. Batteries: Sealed, valve regulated, recombinant, lead calcium.
3. Accessories:

a. Transient voltage suppression.
b. Input-harmonics reduction.
c. Rectifier/charger.
d. Battery disconnect device.
e. Static bypass transfer switch.
f. Internal maintenance bypass/isolation switch.
g. External maintenance bypass/isolation switch.
h. Output isolation transformer.
i. Remote UPS monitoring.
j. Battery monitoring.
k. UPS operation monitoring.
l. Abnormal operation. Visible and audible indication.
m. Remote battery monitoring.

2.9 FIXED MAP DISPLAY

A. A fixed map display shall show layout of the protected facilities. Zones corresponding to those monitored by the system shall be highlighted on the display. Status of each zone shall be displayed using digital displays as required within each designated zone. A digital display test switch shall be provided on the map display. Contractor shall furnish and install display map and shall have it available at the time of owner training. Modifications to map shall be made after training has been complete and

2.10 CONTROLLERS

A. Controllers: Intelligent peripheral control unit, complying with UL 294, that stores time, date, valid codes, access levels, and similar data downloaded from the central station or workstation for controlling its operation.

B. Subject to compliance with requirements in this article, manufacturers may use multipurpose controllers.

C. Battery Backup: Sealed, lead acid; sized to provide run time during a power outage of 90 minutes, complying with UL 924.

D. Alarm Annunciation Controller:

1. The controller shall automatically restore communication within 10 seconds after an interruption with the field device network, with dc line supervision on each of its alarm inputs.

a. Inputs: Monitor dry contacts for changes of state that reflect alarm conditions. Provides at least eight alarm inputs, which are suitable for wiring as normally open or normally closed contacts for alarm conditions.
b. Alarm-Line Supervision:

1) Supervise the alarm lines by monitoring each circuit for changes or disturbances in the signal , and for conditions as described in UL 1076 for line security equipment and by monitoring for abnormal open, grounded, or shorted condition using dc change measurements. System shall initiate an alarm in response to an abnormal current, which is a dc change of 5 percent or more for longer than 500 ms.
2) Transmit alarm-line-supervision alarm to the central station during the next interrogation cycle after the abnormal current condition.

c. Outputs: Managed by central-station software.

2. Auxiliary Equipment Power: A GFI service outlet inside the controller enclosure.

E. Entry-Control Controller:

1. Function: Provide local entry-control functions including one- and two-way communications with access-control devices such as card readers, keypads, biometric personnel identity-verification devices, door strikes, magnetic latches, gate and door operators, and exit push buttons.

a. Operate as a stand-alone portal controller using the downloaded database during periods of communication loss between the controller and the field-device network.
b. Accept information generated by the entry-control devices; automatically process this information to determine valid identification of the individual present at the portal:

1) On authentication of the credentials or information presented, check privileges of the identified individual, allowing only those actions granted as privileges.
2) Privileges shall include, but are not limited to, time of day control, day of week control, group control, and visitor escort control.

c. Maintain a date-, time-, and Location-stamped record of each transaction. A transaction is defined as any successful or unsuccessful attempt to gain access through a controlled portal by the presentation of credentials or other identifying information.

2. Inputs:

a. Data from entry-control devices; use this input to change modes between access and secure.
b. Database downloads and updates from the central station that include enrollment and privilege information.

3. Outputs:

a. Indicate success or failure of attempts to use entry-control devices and make comparisons of presented information with stored identification information.
b. Grant or deny entry by sending control signals to portal-control devices and mask intrusion-alarm annunciation from sensors stimulated by authorized entries.
c. Maintain a date-, time-, and Location-stamped record of each transaction and transmit transaction records to the central station.
d. Door Prop Alarm: If a portal is held open for longer than 20 seconds, alarm sounds.

4. With power supplies sufficient to power at voltage and frequency required for field devices and portal-control devices.
5. Data Line Problems: For periods of loss of communication with the central station, or when data transmission is degraded and generating continuous checksum errors, the controller shall continue to control entry by accepting identifying information, making authentication decisions, checking privileges, and controlling portal-control devices.

    a. Store up to 1000 transactions during periods of communication loss between the controller and access-control devices for subsequent upload to the central station on restoration of communication.

6. Controller Power: NFPA 70, Class II power-supply transformer, with 12- or 24-V ac secondary, backup battery and charger.

    a. Backup Battery: Premium, valve -regulated, recombinant-sealed, lead-calcium battery; spill proof; with a full one-year warranty and a pro rata 19-year warranty. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.
    b. Backup Battery: Valve-regulated, recombinant-sealed, lead-acid battery; spill proof. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.
    c. Backup Power-Supply Capacity: 90 minutes of battery supply. Submit battery and charger calculations.
    d. Power Monitoring: Provide manual, dynamic battery-load test, initiated and monitored at the control center; with automatic disconnection of the controller when battery voltage drops below controller limits. Report by using local controller-mounted digital displays and by communicating status to central station. Indicate normal power on and battery charger on trickle charge. Indicate and report the following:

        1) Trouble Alarm: Normal power-off load assumed by battery.
        2) Trouble Alarm: Low battery.
        3) Alarm: Power off.

2.11 SECONDARY ALARM ANNUNCIATOR

A. Secondary Alarm Annunciation Site: A workstation with limited I/O capacity, consisting of a secondary alarm annunciation workstation to display alarms or system status changes only.

2.12 CARD READERS, CREDENTIAL CARDS, AND KEYPADS

A. Card-Reader Power: Powered from its associated controller, including its standby power source, and shall not dissipate more than 5 W.

B. Response Time: Card reader shall respond to passage requests by generating a signal that is sent to the controller. Response time shall be 800 ms or less, from the time the card reader finishes reading the credential card until a response signal is generated.

C. Enclosure: Suitable for surface, semi-flush, pedestal, or weatherproof mounting. Mounting types shall additionally be suitable for installation in the following locations:

1. Indoors, controlled environment.
2. Indoors, uncontrolled environment.
3. Outdoors, with built-in heaters or other cold-weather equipment to extend the operating temperature range as needed for operation at the site.

D. Display: Digital visual indicator shall provide visible and audible status indications and user prompts. Indicate power on or off, whether user passage requests have been accepted or rejected, and whether the door is locked or unlocked.

E. Stripe Swipe Readers: Bidirectional, reading cards swiped in both directions, powered by the controller. Reader shall be set up for ABA Track.

1. ABA Track: Magnetic stripe that is encoded on track 2, at 75-bpi density in binary-coded decimal format; for example, 5-bit, 16-character set.
2. Readers for outdoors shall be in a polymeric plastic enclosure with all electronics potted in plastic. Rated for operation in ambient conditions of minus 40 to plus 160 deg F (minus 40 to plus 70 deg C) in a humidity range of 10 to 90 percent.

F. Wiegand Swipe Reader: Set up for 33-bit data cards. Comply with SIA AC-01.

G. Wiegand Key-Insert Reader: Set up for 33-bit data cards.

H. Bar-Code Reader: Set up for Code 39 .

I. Insert Readers: Requiring the card to be inserted from the side, powered by the controller.

J. Touch-Plate and Proximity Readers:

1. Active-detection proximity card readers shall provide power to compatible credential cards through magnetic induction, and shall receive and decode a unique identification code number transmitted from the credential card.
2. Passive-detection proximity card readers shall use a swept-frequency, RF field generator to read the resonant frequencies of tuned circuits laminated into compatible credential cards. The resonant frequencies read shall constitute a unique identification code number.
3. The card reader shall read proximity cards in a range from direct contact to at least 6 inches (150 mm) from the reader.

K. Keypads:

1. Entry-control keypads shall use a unique combination of alphanumeric and other symbols as an Identifier.
2. Keypads shall contain an integral alphanumeric/special symbols keyboard with symbols arranged in ascending ASCII-code ordinal sequence Communication protocol shall be compatible with the local processor.

L. Keypad Display:

1. Keypads shall include a digital visual indicator and shall provide visible and audible status indications and user prompts.
2. Display shall indicate power on or off and whether user passage requests have been accepted or rejected.
3. Design of the keypad display or keypad enclosure shall limit viewing angles of the keypad as follows:

    a. Maximum Horizontal Viewing Angle: Plus or minus 5 degrees or less off a vertical plane perpendicular to the plane of the face of the keypad display.
    b. Maximum Vertical Viewing Angle: Plus or minus 15 degrees or less off a horizontal plane perpendicular to the plane of the face of the keypad display.

M. Keypad Response Time:

1. The keypad shall respond to passage requests by generating a signal to the local processor. The response time shall be 800 ms or less from the time the last alphanumeric symbol is entered until a response signal is generated.

N. Keypad Power:

1. The keypad shall be powered from the source as shown and shall not dissipate more than 150 W.

O. Keypad Mounting Method:

1. Keypads shall be suitable for surface, semi-flush, pedestal, or weatherproof mounting as required.

P. Keypad Duress Codes:

1. Keypads shall provide a means for users to indicate a duress situation by entering a special code.

Q. Keypad and Wiegand-Swipe-Reader Combination: Designed to require an entry on the keypad before presenting the credential card.

1. Keypad: Allow the entry of four alphanumeric characters that are associated with a specific credential. Keypads shall contain an integral alphanumeric/special symbol keyboard with symbols arranged in random scrambled order. Keypad display or enclosure shall limit viewing angles of the keypad as follows:

    a. Maximum Horizontal Viewing Angle: Plus or minus 5 degrees or less off a vertical plane perpendicular to the plane of the face of the keypad display.

b. Maximum Vertical Viewing Angle: Plus or minus 15 degrees or less off a horizontal plane perpendicular to the plane of the face of the keypad display.

2. Wiegand Swipe Reader: Set up for 33-bit data cards to generate a unique card identification code. Comply with SIA AC-01.

R. Communication Protocol: Compatible with local processor.

S. Touch-Plate and Contactless Card Reader: The reader shall have "flash" download capability to accommodate card format changes. The card reader shall have capability of transmitting data to security control panel and shall comply with ISO/IEC 7816.

T. Credential Card Modification: Entry-control cards shall be able to be modified by lamination direct print process during the enrollment process without reduction of readability. The design of the credential cards shall allow for the addition of at least one slot or hole to accommodate the attachment of a clip for affixing the credential card to the badge holder used at the site.

U. Card Size and Dimensional Stability: Credential cards shall be [2-1/8 by 3-3/8 inches (54 by 86 mm). The credential card material shall be dimensionally stable so that an undamaged card with deformations resulting from normal use shall be readable by the card reader.

V. Card Material: Abrasion resistant, nonflammable, nontoxic, and impervious to solar radiation and effects of ultraviolet light.

W. Card Construction:

1. Core and laminate or monolithic construction.
2. Lettering, logos, and other markings shall be hot stamped into the credential material or direct printed.
3. Incorporate [holographic images] [phosphorous ink] as a security enhancement.
4. Furnish equipment for on-site assembly and lamination of credential cards.

2.13 BIOMETRIC IDENTITY-VERIFICATION EQUIPMENT

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. BioMet Partners Inc.
2. Bioscrypt Inc.
3. Control Module, Inc.
4. Ingersoll-Rand Company Limited; Recognition Systems.
5. L-1 Identity Solutions, Inc.
6. L-1 Identity Solutions, Inc.; Identix Incorporated Division.

B. Biometric identity-verification templates shall be stored as part of system database files and used as a comparative base by the identity-verification equipment to generate an appropriate signal to the associated controller.

C. Eye Retina Scanner: Designed to incorporate positive measures to establish that the eye retina being scanned by the device belongs to a living human being.

1. Retina scan device shall provide a means that does not require facial contact with the device for enrollees to align their eye for identification. A manual push button shall be provided to initiate the scan process when the enrollee's eye is aligned in front of the device.
2. The efficiency and accuracy of scanner shall not be affected by contact lenses.
3. Storage space for each eye template shall not exceed 512 8-bit bytes.
4. Light-emitting source used for retina scans may not use light levels exceeding 20 percent of the maximum safe level established in the American Conference of Governmental Industrial Hygienists limit values.
5. Template Update: Eye scanner shall not automatically update an enrollee's template. Significant changes in an individual's eye shall require re-enrollment.
6. Scan acceptance tolerance or template match criteria shall be under system manager/operator control. Eye scanner shall determine when multiple attempts are needed for retina verification and shall automatically prompt the enrollee for additional attempts up to a maximum of three. Three failed attempts shall generate an entry-control alarm.
7. Average Verification Time: Eye scanner shall respond to passage requests by generating an entry request signal to the controller. The verification time shall be [1.5 seconds or less from the moment eye scanner initiates the scan process until eye scanner generates a response signal.
8. Modes: Eye scanner shall provide an enrollment mode, a recognition mode, and a code/credential verification mode.

    a. In the enrollment mode, eye scanner shall create an eye template for new personnel and enter the template into the system database file created for that person. Template information shall be compatible with system application software.
    b. In the recognition mode, eye scanner shall allow passage when the eye scan data from the verification attempt match an eye template stored in database files.
    c. In the code/credential verification mode, eye scanner shall allow passage when the eye scan data from the verification attempt match the eye scan template associated with the identification code entered into a keypad, or they match the eye scan template associated with credential card data read by a card reader.

9. Reports: Eye scanner shall create and store template match scores for all transactions involving eye retinal scans. Template match scores shall be stored in the matching personnel data file used for report generation.
10. Power: Scanner shall be powered from its associated controller, requiring not more than 45 W.
11. Enclosure: Eye scanners shall be available with enclosures that are suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:

    a. Indoors, controlled environment.
    b. Indoors, uncontrolled environment.

12. Display: Digital visual indicator shall provide visible and audible status indications and user prompts. Indicate power on or off and whether user passage requests have been accepted or rejected.

D. Hand Geometry: Use unique human hand measurements to identify authorized, enrolled personnel. The design of this device shall incorporate positive measures to establish that the hand being measured by the device belongs to a living human being.

1. The user's hand shall remain in full view of the user at all times. The scan process of the hand geometry device shall make three-dimensional measurements of the size and shape of the subject's hand. Scanning shall start automatically once the user's hand is properly positioned by the alignment system.
2. Hand geometry device shall be able to use either left or right hand for enrollment and verification.
3. Storage space for each hand template shall not exceed 50 8-bit bytes.
4. Template Update and Acceptance Tolerances: Hand geometry devices shall not automatically update a user's profile. Significant changes in an individual's hand geometry shall require re-enrollment. Hand geometry devices shall provide an adjustable acceptance tolerance or template match criteria under system manager/operator control. Hand geometry device shall determine when multiple attempts are needed for hand geometry verification and shall automatically prompt the user for additional attempts up to a maximum of three. Three failed attempts shall generate an entry-control alarm.
5. Average Verification Time: Hand geometry device shall respond to passage requests by generating an entry request signal to the controller. The verification time shall be 1.5 seconds or less from the moment hand geometry device initiates the scan process until hand geometry device generates a response signal.
6. Modes: Hand geometry device shall provide an enrollment mode, a recognition mode, and a code/credential verification mode.

    a. In the enrollment mode, hand geometry device shall create a hand template for new personnel and enter the template into the system database file created for that person. Template information shall be compatible with system application software.
    b. In the recognition mode, hand geometry device shall allow passage when the hand scan data from the verification attempt match a hand geometry template stored in database files.
    c. In the code/credential verification mode, hand geometry device shall allow passage when the hand scan data from the verification attempt match the hand geometry template associated with the identification code entered into a keypad, or they match the hand geometry template associated with credential card data read by a card reader.

7. Reports: Hand geometry device shall create and store template match scores for all transactions involving hand geometry scans. Template match scores shall be stored in the matching personnel data file used for report generation.
8. Power: Hand geometry device shall be powered from its associated controller, requiring not more than 45 W.
9. Enclosure: Geometry readers shall be available with enclosures that are suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:

    a. Indoors, controlled environment.
    b. Indoors, uncontrolled environment.
    c. Outdoors.

10. Display: Digital visual indicator shall provide visible and audible status indications and user prompts. Indicate power on or off and whether user passage requests have been accepted or rejected.

E. Fingerprint Analysis Scanner: Use a unique human fingerprint pattern to identify authorized, enrolled personnel. The design of this device shall incorporate positive measures to establish that the hand or fingers being scanned by the device belong to a living human being.

1. The user's hand shall remain in full view of the user at all times. The scan process of the fingerprint analysis scanner shall perform an optical or other type of scan of the enrollee's fingers. Scanning shall start automatically when the user's fingers are properly positioned.
2. Storage space for each fingerprint template shall not exceed 1250 8-bit bytes.
3. Template Update and Acceptance Tolerances: Fingerprint analysis scanners shall not automatically update an enrollee's profile. Significant changes in an individual's fingerprints shall require re-enrollment. Fingerprint analysis scanners shall provide an adjustable acceptance tolerance or template match criteria under system manager/operator control. Fingerprint analysis scanner shall determine when multiple attempts are needed for fingerprint verification and shall automatically prompt the user for additional attempts up to a maximum of three. Three failed attempts shall generate an entry-control alarm.
4. Average Verification Time: Fingerprint analysis scanner shall respond to passage requests by generating an entry request signal to the controller. The verification time shall be two seconds or less from the moment fingerprint analysis scanner initiates the scan process until fingerprint analysis scanner generates a response signal.
5. Modes: Fingerprint analysis scanner shall provide an enrollment mode, a recognition mode, and a code/credential verification mode.

    a. In the enrollment mode, fingerprint analysis scanner shall create a fingerprint template for new personnel and enter the template into the system database file created for that person.
    b. In the recognition mode, fingerprint analysis scanner shall allow passage when the fingerprint data from the verification attempt match a fingerprint template stored in database files.
    c. In the code/credential verification mode, fingerprint analysis scanner shall allow passage when the fingerprint data from the verification attempt match the fingerprint template associated with the identification code entered into a keypad, or they match the fingerprint template associated with credential card data read by a card reader.

6. Reports: Fingerprint analysis device shall create and store pattern match scores for all transactions involving fingerprint scans. Template match scores shall be stored in the matching personnel data file used for report generation.
7. Power: Fingerprint analysis scanner shall be powered from its associated controller, requiring not more than 45 W.
8. Enclosure: Scanners shall be available with enclosures that are suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:

    a. Indoors, controlled environment.
    b. Indoors, uncontrolled environment.
    c. Outdoors.

9. Display: Digital visual indicator shall provide visible[and audible] status indications and user prompts. Indicate power on or off and whether user passage requests have been accepted or rejected.

F. Iris Scan Device: Use the unique patterns found in the iris of the human eye to identify authorized, enrolled personnel. The device shall use ambient light to capture an image of the iris of a person for identification. The resulting video image shall be compared against a stored template that was captured during the enrollment process. When the presented image is sufficiently similar to the stored image template, then the device shall authenticate the presenting individual as identified. The threshold of similarity shall be adjustable.

1. The efficiency and accuracy of the device shall not be affected by contact lenses or eyeglasses.
2. Iris scan device shall provide a means that does not require facial contact with the device for enrollees to align their eye for identification. A manual push button shall be provided to initiate the scan process when the user's eye is aligned in front of the device.
3. The device shall include adjustments to accommodate differences in enrollee height.
4. Template Update: Iris scanners shall not automatically update an enrollee's template. Significant changes in an individual's eye shall require re-enrollment.
5. Scan acceptance tolerance or template match criteria shall be under system manager/operator control. Iris scanner shall determine when multiple attempts are needed for iris verification and shall automatically prompt the user for additional attempts up to a maximum of three. Three failed attempts shall generate an entry-control alarm.
6. Average Verification Time: Iris scanner shall respond to passage requests by generating an entry request signal to the controller. The verification time shall be 1.5 seconds or less from the moment iris scanner initiates the scan process until iris scanner generates a response signal.
7. Modes: Iris scanner shall provide an enrollment mode, a recognition mode, and a code/credential verification mode.

    a. In the enrollment mode, iris scanner shall create an iris template for new personnel and enter the template into the system database file created for that person. Template information shall be compatible with system application software.
    b. In the recognition mode, iris scanner shall allow passage when the iris scan data from the verification attempt match an iris template stored in database files.
    c. In the code/credential verification mode, iris scanner shall allow passage when the iris scan data from the verification attempt match the iris scan template associated with the identification code entered into a keypad, or they match the iris scan template associated with credential card data read by a card reader.

8. Reports: Iris imaging shall create and store template match scores for all transactions involving iris scans. Template match scores shall be stored in the matching personnel data file used for report generation.
9. Power: Iris scanner shall be powered from its associated controller, requiring not more than 45 W.
10. Enclosure: Eye scanners shall be available with enclosures that are suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:

    a. Indoors, controlled environment.
    b. Indoors, uncontrolled environment.

11. Display: Digital visual indicator shall provide visible and audible status indications and user prompts. Indicate power on or off and whether user passage requests have been accepted or rejected.

2.14 ENROLLMENT CENTER

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Applied Wireless Identifications Group, Inc.
2. Autostar Technology Pte Ltd.
3. Digital Monitoring Products.
4. IDenticard Systems.
5. ISONAS, Inc.
6. Ultra Electronics.

B. Equipment for enrolling personnel into, and removing personnel from, system database, using a dedicated workstation PC

1. Include equipment to enroll selected biometric credentials.

C. Enrollment equipment shall support encoding of credential cards including cryptographic and other internal security checks as required for system.

1. Allow only authorized entry-control enrollment personnel to access the enrollment equipment using passwords.
2. Include enrollment-subsystem configuration controls and electronic diagnostic aids for subsystem setup and troubleshooting with the central station.
3. Enrollment-station records printer shall meet requirements of the report printer.

D. Entry-Control Enrollment Software:

1. Shall include database management functions for the system, and shall allow an operator to change and modify the data entered in the system as needed.
2. Software shall not have alarm response or acknowledgment functions as a programmable function.
3. Multiple, password-protected access levels shall be provided at the enrollment station.
4. Database management and modification functions shall require a higher operator-access level than personnel enrollment functions.
5. Software shall provide a means for disabling the enrollment station when it is unattended, to prevent unauthorized use.
6. Software shall provide a method to enter personnel identifying information into the entry-control database files through enrollment stations to include a credential unit in use at the installation.
7. In the case of personnel identity-verification subsystems, this data shall include biometric data.
8. Software shall allow entry of this data into the system database files through the use of simple menu selections and data fields. The data field names shall be customized to suit user and site needs.
9. Personnel identity-verification subsystems selected for use with the system shall fully support the enrollment function and shall be compatible with the entry-control database files.

E. Accessories:

1. Steel desk-type console, swivel chair on casters, and equipment racks.

2. Console and Equipment Racks: Comply with EIA/ECA-310-E.
3. Equipment, with the exception of the printers, shall be rack mounted in the console and equipment racks.
4. Storage Cabinet: Locking cabinet approximately 72 inches (1830 mm) high, 36 inches (915 mm) wide, and 24 inches (610 mm) deep, with three adjustable shelves and two storage racks for storage of disks, tapes, printouts, printer paper, ribbons, manuals, and other documentation.

F. System Capacity: Number of badges shall be limited only by hard disk space. Badge templates and images shall be in color, supporting the maximum color capability of Microsoft Windows.

G. Badge Configuration:

1. Software for badge template creation shall include a template consisting of background and predetermined locations of photographs, text objects and data fields for text, and bar-code and biometric information. Include automatic sizing of data fields placed on a badge to compensate for names, which may otherwise be too large to fit in the area designated.
2. Allow different badge templates to be used for each department, tenant, or visitor.
3. As a setup option, templates shall be automatically selected for the badge, based on the group to which the credential holder is assigned. Allow the operator to override the automatic template selection and use a template chosen by the operator for creating a badge.
4. Setup shall determine which graphics and credential-holder information will be displayed and where on the card it will be placed. All data in the security access system, such as name, code, group, access level, and any of the 99 user-defined fields, shall be selectable, with the ability to place them anywhere on the card.
5. System shall include an importing, filing, and recall system of stored images and shapes that can be placed on the badge.
6. Allow multiple images on the same badge, including, but not limited to, bar codes, digital photos, and signatures.
7. Support transparent backgrounds so that image is only surrounded by the intended background and not by its immediate background.

H. Photo Imaging: Integral to security access.

1. Import images from bitmap file formats, digital cameras, TWAIN cameras, or scanners. Allow image cropping and editing, WYSIWYG badge-building application, and badge print-preview and printing capabilities.
2. System shall support multiple images stored for each credential holder, including signatures, portrait views, and profile views.

I. Text Objects: Badge configuration shall provide for creation of custom text as an object, allowing font selection, typing, scaling, and formatting of the text object. Formatting options shall include changing font, font size, text flow, and text alignment; bending or curving the text object into a circle or semicircle; applying 3-D effects; and applying predefined effects such as tilt, extrusion, or beveling. Text shall be placed and optionally automatically centered within any region of the badge layout.

J. Badges and Credential Cards:

1. Badges are credential cards that do not contain data to be read by card readers.

2. Credential cards shall store uniquely coded data used by card readers as an Identifier.

    a. Magnetic-Stripe Cards: Comply with ISO/IEC 7810, ISO/IEC 7811-1, ISO/IEC 7811-2, ISO/IEC 7811-6, and ISO/IEC 7811-7. Use single-layer magnetic tape material that is coated with a plastic, slick protective coat and affixed to the back of the credential card near the top.
    b. Wiegand Wire-Effect Cards: Ferromagnetic wires laminated into the credential card using binary digits specified for Wiegand readers to generate a unique credential card identification code.
    c. Proximity Cards: Use proximity detection without physical contact with the reader for proper operation.

3. Allow entry-control card to be modified by lamination or direct print process during the enrollment process for use as a picture and identification badge without reduction of readability. The design shall allow for the addition of at least one slot or hole to accommodate the attachment of a clip for affixing the credential card to the type of badge holder used at the site.

    a. Card Size and Dimensional Stability: Standard size, [2-1/8 by 3-3/8 inches (54 by 86 mm); dimensionally stable so that an undamaged card with deformations resulting from normal use shall be readable by the card reader.
    b. Card Material: Abrasion resistant, nonflammable, and nontoxic; and impervious to solar radiation and effects of ultraviolet light.
    c. Card Construction: Core and laminate or monolithic construction. Lettering, logos, and other markings shall be hot stamped into the credential material or direct printed.

        1) Incorporate holographic images as a security enhancement.
        2) Furnish equipment for on-site assembly and lamination of credential cards.

    d. Card Durability and Maintainability: Designed and constructed to yield a useful lifetime of at least five years or 5000 insertions or swipes, whichever results in a longer period of time. Allow credential cards to be cleaned by wiping with a sponge or cloth wetted with soap and water.

K. Card-Making Equipment: Consisting of a workstation, video camera, video-imaging equipment, and a printer.

1. Camera: NTSC color standard, RGB video output, 470 lines minimum horizontal resolution, and automatic white balance with full rated output under illumination of 0.5 fc (5 lx).
2. Video Imaging: Live-image capture software and hardware and a digital signature capture pad.
3. Standard workstation, modified as follows:

    a. Redundant workstation is not required.
    b. Printer is not required.
    c. UPS is not required.
    d. Sound card is not required.

4. Printer: Dye-sublimation resin thermal transfer, 300 dpi resolution, 16.7 million colors, accepting cards ranging in size from 2.1 by 3 inches to 2.6 by 3.7 inches (53 by 76 mm to 66 by 94 mm) and having card thickness ranging from 0.020 to 0.060 inch (0.5 to 1.5

mm). Printer shall have options for encoding magnetic stripe using tracks 1, 2, and 3. Throughput shall be not less than 60 seconds per card.

2.15 PUSH-BUTTON SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Securitron Magnalock Corporation; an ASSA ABLOY Group company.

B. Push-Button Switches: Momentary-contact back-lighted push buttons with stainless-steel switch enclosures.

C. Electrical Ratings:

1. Minimum continuous current rating of 10 A at 120-V ac
2. Contacts that will make 720 VA at 60 A and that will break at 720 VA at 10 A.

D. Enclosures: Flush or surface mounting. Push buttons shall be suitable for flush mounting in the switch enclosures.

E. Enclosures shall additionally be suitable for installation in the following locations:

1. Indoors, controlled environment.
2. Indoors, uncontrolled environment.
3. Outdoors.

F. Power: Push-button switches shall be powered from their associated controller, using dc control.

2.16 DOOR AND GATE HARDWARE INTERFACE

A. Exit Device with Alarm: Operation of the exit device shall generate an alarm and annunciate a local alarm. Exit device and alarm contacts are specified in Division 08 Section "Door Hardware."

B. Exit Alarm: Operation of a monitored door shall generate an alarm. Exit devices and alarm contacts are specified in Division 08 Section "Door Hardware."

C. Electric Door Strikes: Use end-of-line resistors to provide power-line supervision. Signal switches shall transmit data to controller to indicate when the bolt is not engaged and the strike mechanism is unlocked, and they shall report a forced entry. Power and signal shall be from the controller. Electric strikes are specified in Division 08 Section "Door Hardware."

D. Electromagnetic Locks: End-of-line resistors shall provide power-line supervision. Lock status sensing signal shall positively indicate door is secure. Power and signal shall be from the controller. Electromagnetic locks are specified in Division 08 Section "Door Hardware."

2.17 FIELD-PROCESSING SOFTWARE

A. Operating System:

1. Local processors shall contain an operating system that controls and schedules that local processor's activities in real time.
2. Local processor shall maintain a point database in its memory that includes parameters, constraints, and the latest value or status of all points connected to that local processor.
3. Execution of local processor application programs shall utilize the data in memory resident files.
4. Operating system shall include a real-time clock function that maintains the seconds, minutes, hours, date, and month, including day of the week.
5. Local processor real-time clock shall be automatically synchronized with the central station at least once per day to plus or minus 10 seconds (the time synchronization shall be accomplished automatically, without operator action and without requiring system shutdown).

B. Startup Software:

1. Causes automatic commencement of operation without human intervention, including startup of all connected I/O functions.
2. Local processor restart program based on detection of power failure at the local processor shall be included in the local processor software.
3. Initiates operation of self-test diagnostic routines.
4. Upon failure of the local processor, if the database and application software are no longer resident, the local processor shall not restart and systems shall remain in the failure mode indicated until the necessary repairs are made.
5. If the database and application programs are resident, the local processor shall immediately resume operation.

C. Operating Mode:

1. Local processors shall control and monitor inputs and outputs as specified, independent of communications with the central station or designated workstations.
2. Alarms, status changes, and other data shall be transmitted to the central station or designated workstations when communications circuits are operable.
3. If communications are not available, each local processor shall function in a stand-alone mode and operational data, including the status and alarm data normally transmitted to the central station or designated workstations, shall be stored for later transmission to the central station or designated workstations.
4. Storage for the latest 4000 events shall be provided at local processors, as a minimum.
5. Local processors shall accept software downloaded from the central station.
6. Panel shall support flash ROM technology to accomplish firmware downloads from a central location.

D. Failure Mode: Upon failure for any reason, each local processor shall perform an orderly shutdown and force all local processor outputs to a predetermined (failure-mode) state, consistent with the failure modes shown and the associated control device.

E. Functions:

1. Monitoring of inputs.
2. Control of outputs.

3. Reporting of alarms automatically to the central station.
4. Reporting of sensor and output status to central station upon request.
5. Maintenance of real time, automatically updated by the central station at least once a day.
6. Communication with the central station.
7. Execution of local processor resident programs.
8. Diagnostics.
9. Download and upload data to and from the central station.

2.18 FIELD-PROCESSING HARDWARE

A. Alarm Annunciation Local Processor:

1. Respond to interrogations from the field device network, recognize and store alarm status inputs until they are transmitted to the central station, and change outputs based on commands received from the central station.
2. Local processor shall also automatically restore communication within 10 seconds after an interruption with the field device network and provide dc line supervision on each of its alarm inputs.
3. Local processor inputs shall monitor dry contacts for changes of state that reflect alarm conditions.
4. Local processor shall have at least eight alarm inputs which allow wiring contacts as normally open or normally closed for alarm conditions; and shall provide line supervision for each input by monitoring each input for abnormal open, grounded, or shorted conditions using dc current change measurements.
5. Local processor shall report line supervision alarms to the central station.
6. Alarms shall be reported for any condition that remains abnormal at an input for longer than 500 milliseconds.
7. Alarm condition shall be transmitted to the central computer during the next interrogation cycle.
8. Local processor outputs shall reflect the state of commands issued by the central station.
9. Outputs shall be a form C contact and shall include normally open and normally closed contacts.
10. Local processor shall have at least four command outputs.
11. Local processor shall be able to communicate with the central station via RS-485 or TCP/IP as a minimum.

B. Processor Power Supply:

1. Local processor and sensors shall be powered from an uninterruptible power source.
2. Uninterruptible power source shall provide eight hours of battery back-up power in the event of primary power failure and shall automatically fully recharge the batteries within 12 hours after primary power is restored.
3. If the facility is without an emergency generator, the uninterruptible power source shall provide 24 hours of battery backup power.
4. There shall be no equipment malfunctions or perturbations or loss of data during the switch from primary to battery power and vice versa.
5. Batteries shall be sealed, non-outgassing type.
6. Power supply shall be equipped with an indicator for ac input power and an indicator for dc output power.
7. Loss of primary power shall be reported to the central station as an alarm.

C. Auxiliary Equipment Power: A GFI service outlet shall be furnished inside the local processor's enclosure.

D. Entry-Control Local Processor:

1. Entry-control local processor shall respond to interrogations from the field device network, recognize and store alarm status inputs until they are transmitted to the central station, and change outputs based on commands received from the central station.
2. Local processor shall also automatically restore communication within 10 seconds after an interruption with the field device network and provide dc line supervision on each of its alarm inputs.
3. Entry-control local processor shall provide local entry-control functions including communicating with field devices such as card readers, keypads, biometric personnel identity-verification devices, door strikes, magnetic latches, gate and door operators, and exit push buttons.
4. Processor shall also accept data from entry-control field devices as well as database downloads and updates from the central station that include enrollment and privilege information.
5. Processor shall send indications of successful or failed attempts to use entry-control field devices and shall make comparisons of presented information with stored identification information.
6. Processor shall grant or deny entry by sending control signals to portal-control devices and mask intrusion-alarm annunciation from sensors stimulated by authorized entries.
7. Entry-control local processor shall use inputs from entry-control devices to change modes between access and secure.
8. Local processor shall maintain a date-time- and location-stamped record of each transaction and transmit transaction records to the central station.
9. Processor shall operate as a stand-alone portal controller using the downloaded database during periods of communication loss between the local processor and the central station.
10. Processor shall store a minimum of 4000 transactions during periods of communication loss between the local processor and the central station for subsequent upload to the central station upon restoration of communication.
11. Local processor inputs shall monitor dry contacts for changes of state that reflect alarm conditions.
12. Local processor shall have at least eight alarm inputs which allow wiring contacts as normally open or normally closed for alarm conditions; and shall also provide line supervision for each input by monitoring each input for abnormal open, grounded, or shorted conditions using dc current change measurements.
13. Local processor shall report line supervision alarms to the central station.
14. Alarms shall be reported for any condition that remains abnormal at an input for longer than 500 ms.
15. Alarm condition shall be transmitted to the central station during the next interrogation cycle.
16. Entry-control local processor shall include the necessary software drivers to communicate with entry-control field devices. Information generated by the entry-control field devices shall be accepted by the local processor and automatically processed to determine valid identification of the individual present at the portal.
17. Upon authentication of the credentials or information presented, the local processor shall automatically check privileges of the identified individual, allowing only those actions granted as privileges.

18. Privileges shall include, but are not limited to, time of day control, day of week control, group control, and visitor escort control. The local processor shall maintain a date-time- and location-stamped record of each transaction.
19. Transaction is defined as any successful or unsuccessful attempt to gain access through a controlled portal by the presentation of credentials or other identifying information.
20. Local processor outputs shall reflect the state of commands issued by the central station.
21. Outputs shall be a form C contact and shall include normally open and normally closed contacts.
22. Local processor shall have at least four addressable outputs.
23. The entry-control local processor shall also provide control outputs to portal-control devices.
24. Local processor shall be able to communicate with the central station via RS-485 or TCP/IP as a minimum.
25. The system manufacturer shall provide strategies for downloading database information for panel configurations and cardholder data to minimize the required download time when using IP connectivity.

2.19 TIA 232-F ASCII INTERFACE SPECIFICATIONS

A. ASCII interface shall allow TIA 232-F connections to be made between the control station operating as the host PC and any equipment that will accept TIA 232-F ASCII command strings, such as CCTV switches, intercoms, and paging systems.

1. Alarm inputs in system shall allow for individual programming to output up to four unique ASCII character strings through two different COM ports on the host PC.
2. Inputs shall have the ability to be defined to transmit a unique ASCII string for alarm and one for restore through one COM port, and a unique ASCII string for a nonalarm, abnormal condition and one for a normal condition through the same or different COM port.
3. Predefined ASCII character strings shall have the ability to be up to 420 characters long with full use of all the ASCII control characters, such as return or line feed. Character strings shall be defined in the system database and then assigned to the appropriate inputs.
4. COM ports of the host PC used to interface with external equipment shall be defined in the setup portion of the software. COM port's baud rate, word length, stop bits, and parity shall be definable in the software to match that of the external equipment.

B. Pager-System Interface: Alarms shall be able to activate a pager system with customized message for each input alarm.

1. TIA 232-F output shall be capable of connection to a pager interface that can be used to call a paging system or service and send a signal to a portable pager. System shall allow an individual alphanumeric message per alarm input to be sent to the paging system. This interface shall support both numeric and alphanumeric pagers.

C. Alarm-System Interface:

1. TIA 232-F output shall be capable of transmitting alarms from other monitoring and alarm systems to central-station automation software.
2. Alternatively, alarms that are received by this access-control system are to be transferred to the alarm automation system as if they were sent through a digital alarm receiver.

a. System shall be able to transmit an individual message from any alarm input to a burglar-alarm automation monitoring system.
b. System shall be able to append to each message a predefined set of character strings as a prefix and a suffix.

2.20 FLOOR-SELECT ELEVATOR CONTROL

A. Elevator access control shall be integral to security access.

1. System shall be capable of providing full elevator security and control through dedicated controllers without relying on the control-station host PC for elevator control decisions.
2. Access-control system shall enable and disable car calls on each floor and floor-select buttons in each elevator car, restricting passengers' access to the floors where they have been given access.
3. System setup shall, through programming, automatically and individually secure and unsecure each floor-select button of a car by time and day. Each floor-select button within a car shall be separately controlled so that some floors may be secure while others remain unsecure.
4. When a floor-select button is secure, it shall require the passenger to use his or her access code and gain access to that floor before the floor-select button will operate. The passenger's credential shall determine which car call and floor-select buttons are to be enabled, restricting access to floors unless authorized by the system's access code database. Floor-select button shall be enabled only in the car where the credential holder is the passenger.

B. Security access system shall record which call button is pressed, along with credential and time information.

1. System controller shall record elevator access data.
2. The controller shall reset all additional call buttons that may have been enabled by the user's credential.
3. The floor-select elevator control shall allow for manual override from a workstation PC either by individual floor or by cab.

2.21 REAL-TIME GUARD TOUR

A. Guard tour module shall provide the ability to plan, track, and route tours. Module shall input an alarm during tour if guard fails to make a station. Tours can be programmed for sequential or random tour-station order.

1. Guard tour setup shall define specific routes or tours for the guard to take, with time restrictions in which to reach every predefined tour station.
2. Guard tour activity shall be automatically logged to the central-station PC's hard drive.
3. If the guard is early or late to a tour station, a unique alarm per station shall appear at the central station to indicate the time and station.
4. Guard tour setup shall allow the tours to be executed sequentially or in a random order with an overall time limit set for the entire tour instead of individual times for each tour station.
5. Setup shall allow recording of predefined responses that will display for the operator at the control station should a "Failed to Check In" alarm occur.

B. Guard tour module shall allow proprietary direct-connected systems to use security access-control hardware to perform guard tour management in real time.

C. A tour station is a physical location where a guard shall go and perform an action indicating that he or she has arrived. This action, performed at the tour station, shall be one of 13 different events with any combination of station types within the same tour. An event at a tour station shall be one of the following types:

1. Access Granted.
2. Access Denied Code.
3. Access Denied Card plus PIN.
4. Access Denied Time Zone.
5. Access Denied Level.
6. Access Denied Facility.
7. Access Denied Code Timer.
8. Access Denied Anti-Passback.
9. Access Granted Passback Violation.
10. Alarm.
11. Restored.
12. Input Normal.
13. Input Abnormal.

D. Guard tour and other system features shall operate simultaneously with no interference.

E. Guard Tour Module Capacity: 999 possible guard tour definitions with each tour having up to 99 tour stations. System shall allow all 999 tours to be running at the same time.

2.22 VIDEO AND CAMERA CONTROL

A. Control station or designated workstation displays live video from a CCTV source.

1. Control Buttons: On the display window, with separate control buttons to represent Left, Right, Up, Down, Zoom In, Zoom Out, Scan, and a minimum of two custom-command auxiliary controls.
2. Provide at least seven icons to represent different types of cameras, with ability to import custom icons. Provide option for display of icons on graphic maps to represent their physical location.
3. Provide the alarm-handling window with a command button that will display the camera associated with the alarm point.

B. Display mouse-selectable icons representing each camera source, to select source to be displayed. For CCTV sources that are connected to a video switcher, control station shall automatically send control commands through a COM port to display the requested camera when the camera icon is selected.

C. Allow cameras with preset positioning to be defined by displaying a different icon for each of the presets. Provide control with Next and Previous buttons to allow operator to cycle quickly through the preset positions.

2.23 CABLES

A. General Cable Requirements: Comply with requirements in Division 28 Section "Conductors and Cables for Electronic Safety and Security" and as recommended by system manufacturer for integration requirement.

B. PVC-Jacketed, TIA 232-F Cables:

1. Two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, and individual aluminum-foil/polyester-tape shielded pairs with 100 percent shield coverage; PVC jacket.
2. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
3. NFPA 70, Type CM.
4. Flame Resistance: UL 1581 vertical tray.

C. Plenum-Type, TIA 232-F Cables:

1. Two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum-foil/polyester-tape shielded pairs with 100 percent shield coverage; plastic jacket.
2. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
3. NFPA 70, Type CMP.
4. Flame Resistance: NFPA 262 flame test.

D. PVC-Jacketed, TIA 485-A Cables: Two pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, PVC insulation, unshielded, PVC jacket, and NFPA 70, Type CMG.

E. Plenum-Type, TIA 485-A Cables:

1. Two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and fluorinated-ethylene-propylene jacket.
2. NFPA 70, Type CMP.
3. Flame Resistance: NFPA 262 flame test.

F. Multiconductor, PVC, Reader and Wiegand Keypad Cables:

1. No. 22 AWG, paired and twisted multiple conductors, stranded (7x30) tinned copper conductors, semirigid PVC insulation, overall aluminum-foil/polyester-tape shield with 100 percent shield coverage, plus tinned copper braid shield with 65 percent shield coverage, and PVC jacket.
2. NFPA 70, Type CMG.
3. Flame Resistance: UL 1581 vertical tray.
4. For TIA 232-F applications.

G. Paired, PVC, Reader and Wiegand Keypad Cables:

1. Three pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, individual aluminum-foil/polyester-tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and PVC jacket.

2. NFPA 70, Type CM.
3. Flame Resistance: UL 1581 vertical tray.

H. Paired, PVC, Reader and Wiegand Keypad Cables:

1. Three pairs, twisted, No. 20 AWG, stranded (7x28) tinned copper conductors, polyethylene (polyolefin) insulation, individual aluminum-foil/polyester-tape shielded pairs each with No. 22 AWG, stranded (19x34) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
2. NFPA 70, Type CM.
3. Flame Resistance: UL 1581 vertical tray.

I. Paired, Plenum-Type, Reader and Wiegand Keypad Cables:

1. Three pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, individual aluminum-foil/polypropylene-tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and fluorinated-ethylene-propylene jacket.
2. NFPA 70, Type CMP.
3. Flame Resistance: NFPA 262 flame test.

J. Multiconductor, Plenum-Type, Reader and Wiegand Keypad Cables:

1. Six conductors, No. 20 AWG, stranded (7x28) tinned copper conductors, fluorinated-ethylene-propylene insulation, overall aluminum-foil/polyester-tape shield with 100 percent shield coverage plus tinned copper braid shield with 85 percent shield coverage, and fluorinated-ethylene-propylene jacket.
2. NFPA 70, Type CMP.
3. Flame Resistance: NFPA 262 flame test.

K. Paired, Lock Cables:

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
2. NFPA 70, Type CMG.
3. Flame Resistance: UL 1581 vertical tray.

L. Paired, Plenum-Type, Lock Cables:

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
2. NFPA 70, Type CMP.
3. Flame Resistance: NFPA 262 flame test.

M. Paired, Lock Cables:

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
2. NFPA 70, Type CMG.
3. Flame Resistance: UL 1581 vertical tray.

N. Paired, Plenum-Type, Lock Cables:

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.
2. NFPA 70, Type CMP.
3. Flame Resistance: NFPA 262 flame test.

O. Paired, Input Cables:

1. One pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, overall aluminum-foil/polyester-tape shield with No. 22 AWG, stranded (7x30) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
2. NFPA 70, Type CMR.
3. Flame Resistance: UL 1666 riser flame test.

P. Paired, Plenum-Type, Input Cables:

1. One pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, aluminum-foil/polyester-tape shield (foil side out), with No. 22 AWG drain wire, 100 percent shield coverage, and plastic jacket.
2. NFPA 70, Type CMP.
3. Flame Resistance: NFPA 262 flame test.

Q. Paired, AC Transformer Cables:

1. One pair, twisted, No. 18 AWG, stranded (7x26) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
2. NFPA 70, Type CMG.

R. Paired, Plenum-Type, AC Transformer Cables:

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.
2. NFPA 70, Type CMP.
3. Flame Resistance: NFPA 262 flame test.

S. Elevator Travel Cables:

1. Steel center core with shielded, twisted pairs, No. 20 AWG conductor size.
2. Steel center core support shall be preformed, flexible, low-torsion, zinc-coated, steel wire rope; insulated with 60 deg C flame-resistant PVC and covered with a nylon or cotton braid.
3. Shielded pairs shall be insulated copper conductors; color-coded, insulated with 60 deg C flame-resistant PVC; each pair shielded with bare copper braid for 85 percent coverage.
4. Electrical grade, dry jute filler.
5. Helically wound synthetic fiber binder.
6. Rayon or cotton braid applied with 95 percent coverage.
7. 60 deg C PVC jacket specifically compounded for flexibility and abrasion resistance; and complying with UL VW-1 and CSA FT1 flame rated.

T. LAN Cabling:

1. Comply with requirements in Division 28 Section "Conductors and Cables for Electronic Safety and Security."

2. NFPA 262.

2.24 TRANSFORMERS

A. NFPA 70, Class II control transformers, NRTL listed. Transformers for security access-control system shall not be shared with any other system.

2.25 CABLE AND ASSET MANAGEMENT SOFTWARE

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Greenlee Textron Inc.; a subsidiary of Textron Inc.
2. Total Wire Software Company, Inc.

B. Computer-based cable and asset management system, with fully integrated database and graphic capabilities, complying with requirements in TIA/EIA 606-A.

1. Document physical characteristics by recording the network, asset, user, TIA/EIA details, device configurations, and exact connections between equipment and cabling.

a. Manage the physical layer of security system.
b. List device configurations.
c. List and display circuit connections.
d. Record firestopping data.
e. Record grounding and bonding connections and test data.

2. Information shall be presented in database view, schematic plans, or technical drawings.

a. Microsoft Visio Technical Drawing shall be used as drawing and schematic plans software. Drawing symbols, system layout, and design shall comply with SIA/IAPSC AG-01.

3. System shall interface with the following testing and recording devices:

a. Direct-upload tests from circuit testing instrument into the PC.
b. Direct-download circuit labeling into labeling printer.

C. Software shall be designed for windows of the same version as security access system's central station and workstations and shall be installed on the designated PC, using a hard drive dedicated only to this management function. Hard-drive capacity shall be not less than 50 GB.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

B. Examine roughing-in for LAN and control cable conduit systems to PCs, controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with recommendations in SIA CP-01.

B. Comply with TIA/EIA 606-A, "Administration Standard for Commercial Telecommunications Infrastructure."

C. Obtain detailed Project planning forms from manufacturer of access-control system; develop custom forms to suit Project. Fill in all data available from Project plans and specifications and publish as Project planning documents for review and approval.

1. Record setup data for control station and workstations.
2. For each Location, record setup of controller features and access requirements.
3. Propose start and stop times for time zones and holidays, and match up access levels for doors.
4. Set up groups, facility codes, linking, and list inputs and outputs for each controller.
5. Assign action message names and compose messages.
6. Set up alarms. Establish interlocks between alarms, intruder detection, and video surveillance features.
7. Prepare and install alarm graphic maps.
8. Develop user-defined fields.
9. Develop screen layout formats.
10. Propose setups for guard tours and key control.
11. Discuss badge layout options; design badges.
12. Complete system diagnostics and operation verification.
13. Prepare a specific plan for system testing, startup, and demonstration.
14. Develop acceptance test concept and, on approval, develop specifics of the test.
15. Develop cable and asset-management system details; input data from construction documents. Include system schematics and Visio Technical Drawings in electronic format AutoCAD 2013.

D. In meetings with Architect and Owner, present Project planning documents and review, adjust, and prepare final setup documents. Use final documents to set up system software.

3.3 CABLING

A. Comply with NECA 1, "Good Workmanship in Electrical Construction."

B. Install cables and wiring according to requirements in Division 28 Section "Conductors and Cables for Electronic Safety and Security."

C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.

D. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use NRTL-listed plenum cable in environmental airspaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.

E. Install LAN cables using techniques, practices, and methods that are consistent with Category 5E rating of components and fiber-optic rating of components, and that ensure Category 6 and fiber-optic performance of completed and linked signal paths, end to end.

F. Boxes and enclosures containing security-system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.

G. Install end-of-line resistors at the field device location and not at the controller or panel location.

3.4 CABLE APPLICATION

A. Comply with TIA 569-B, "Commercial Building Standard for Telecommunications Pathways and Spaces."

B. Cable application requirements are minimum requirements and shall be exceeded if recommended or required by manufacturer of system hardware.

C. TIA 232-F Cabling: Install at a maximum distance of 50 ft. (15 m).

D. TIA 485-A Cabling: Install at a maximum distance of 4000 ft. (1220 m).

E. Card Readers and Keypads:

1. Install number of conductor pairs recommended by manufacturer for the functions specified.
2. Unless manufacturer recommends larger conductors, install No. 22 AWG wire if maximum distance from controller to the reader is 250 ft. (75 m), and install No. 20 AWG wire if maximum distance is 500 ft. (150 m).
3. For greater distances, install "extender" or "repeater" modules recommended by manufacturer of the controller.
4. Install minimum No. 18 AWG shielded cable to readers and keypads that draw 50 mA or more.

F. Install minimum No. 16 AWG cable from controller to electrically powered locks. Do not exceed 250 ft. (75 m)] [500 ft. (150 m).

G. Install minimum No. 18 AWG ac power wire from transformer to controller, with a maximum distance of [25 ft. (8 m).

3.5 GROUNDING

A. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Comply with IEEE 1100, "Recommended Practice for Power and Grounding Electronic Equipment."

C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

D. Bond shields and drain conductors to ground at only one point in each circuit.

E. Signal Ground:

1. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
2. Bus: Mount on wall of main equipment room with standoff insulators.
3. Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

3.6 INSTALLATION

A. Push Buttons: Where multiple push buttons are housed within a single switch enclosure, they shall be stacked vertically with each push-button switch labeled with 1/4-inch- (6.4-mm-) high text and symbols as required. Push-button switches shall be connected to the controller associated with the portal to which they are applied, and shall operate the appropriate electric strike, electric bolt, or other facility release device.

B. Install card readers, keypads, push buttons, and biometric readers.

3.7 IDENTIFICATION

A. In addition to requirements in this article, comply with applicable requirements in Division 26 Section "Identification for Electrical Systems" and with TIA/EIA 606-A.

B. Using software specified in "Cable and Asset Management Software" Article, develop cable administration drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable, and label cable and jacks, connectors, and terminals to which it connects with the same designation. Use logical and systematic designations for facility's architectural arrangement.

C. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

1. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as shown.
2. Each wire connected to building-mounted devices is not required to be numbered at the device if the color of the wire is consistent with the associated wire connected and numbered within the panel or cabinet.

D. At completion, cable and asset management software shall reflect as-built conditions.

3.8 SYSTEM SOFTWARE AND HARDWARE

A. Develop, install, and test software and hardware, and perform database tests for the complete and proper operation of systems involved. Assign software license to Owner.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 5 tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA 568-B.1, "Commercial Building Telecommunications Cabling Standards - Part 1: General Requirements." Link performance for UTP cables must comply with minimum criteria in TIA/EIA 568-B.1.
2. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power-supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.
3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

C. Devices and circuits will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 STARTUP SERVICE

A. Engage a factory-authorized service representative to supervise and assist with startup service.

1. Complete installation and startup checks according to approved procedures that were developed in "Preparation" Article and with manufacturer's written instructions.
2. Enroll and prepare badges and access cards for Owner's operators, management, and security personnel.

3.11 PROTECTION

A. Maintain strict security during the installation of equipment and software. Rooms housing the control station, and workstations that have been powered up shall be locked and secured with an activated burglar alarm and access-control system reporting to a central station complying with UL 1610, "Central-Station Burglar-Alarm Units," during periods when a qualified operator in the employ of Contractor is not present.

3.12 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain security access system. See Division 01

B. Develop separate training modules for the following:

1. Computer system administration personnel to manage and repair the LAN and databases and to update and maintain software.
2. Operators who prepare and input credentials to man the control station and workstations and to enroll personnel.
3. Security personnel.
4. Hardware maintenance personnel.
5. Corporate management.

END OF SECTION 281300

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE- ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes fire alarm systems.

1.2 DEFINITIONS

A. FACP: Fire alarm control panel.

B. LED: Light-emitting diode.

C. NICET: National Institute for Certification in Engineering Technologies.

D. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

E. Local and State building codes as reviewed by the local Authority Having Jurisdication.

1.3 SYSTEM DESCRIPTION

A. Noncoded, analog-addressable system; automatic sensitivity control of certain smoke detectors; and multiplexed signal transmission dedicated to fire alarm service only.

1.4 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 72 National Fire Alarm Code

B. Comply with NFPA 101 Life Safety Code..

C. Premises protection includes educational facilities.

D. Fire alarm signal initiation shall be by one or more of the following devices:
1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Verified automatic alarm operation of smoke detectors.
5. Automatic sprinkler system water flow.
6. Fire extinguishing system operation.
7. Fire standpipe system.

E. Fire alarm signal shall initiate the following actions:
1. Alarm notification appliances shall operate continuously.
2. Identify alarm at the FACP and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Switch heating, ventilating, and air-conditioning equipment controls to fire alarm mode.

5. Close smoke dampers in air ducts of system serving zone where alarm was initiated.
6. Record events in the system memory.

F. Supervisory signal initiation shall be by one or more of the following devices or actions:
1. Operation of a fire-protection system valve tamper.

G. System trouble signal initiation shall be by one or more of the following devices or actions:
1. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.
2. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at the FACP.
4. Ground or a single break in FACP internal circuits.
5. Abnormal ac voltage at the FACP.
6. A break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at the FACP or annunciator.
9.

H. System Trouble and Supervisory Signal Actions: Ring trouble bell and annunciate at the FACP and remote annunciators.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:
1. Shop Drawings shall be prepared by persons with the following qualifications:
   a. Trained and certified by manufacturer in fire alarm system design.
   b. Fire alarm certified by NICET, minimum Level III.
2. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
3. Device Address List: Coordinate with final system programming.
4. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.
5. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.
6. Batteries: Size calculations.
7. Duct Smoke Detectors: Performance parameters and installation details for each detector, verifying that each detector is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
8. Ductwork Coordination Drawings: Plans, sections, and elevations of ducts, drawn to scale and coordinating the installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, the detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
9. Floor Plans: Indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
10. Submittals shall be indexed by Specification Section 13851. Drawings will not be reviewed unless submittals are complete.

C. Operation and Maintenance Data: For fire alarm system to include in emergency, operation, and maintenance manuals. Comply with NFPA 72, Appendix A, recommendations for Owner's manual. Include abbreviated operating instructions for mounting at the FACP.

D. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in Division 1 Section "Submittals," make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review.

E. Documentation:
1. Approval and Acceptance: Provide the "Record of Completion" form according to NFPA 72 to Owner, Architect, and authorities having jurisdiction.
2. Record of Completion Documents: Provide the "Permanent Records" according to NFPA 72 to Owner, Architect, and authorities having jurisdiction. Format of the written sequence of operation shall be the optional input/output matrix.
   a. Hard copies on paper to Owner.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project. The installing Contractor shall provide proof of their qualifications aas Factory Authorized and Factory Trained for the products specified herein. The documens shall be included in the submittal package. A letter from the manufacturer stating that the Contractor is the Factory Authorized Distributor for the submitted equipment shall be included in the submittal package.

B. The installing contractor shall have completed a minimum of five projects of similar size and scope wilthin the past five years. Provide a list of completed projects including names and phone numbers of Owner’s representatives and General Contractor for the project.

C. Installer Qualifications: Personnel certified by NICET as Fire Alarm Level III. One full time employee with a current Texas Fire Alarm Planning Superintendents License. A minimum of two technicians with Factory Training for the submitted products. Submit copy of licenses.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. The installation shall be performed by Licensed full time employees of the Factory Authorized Distributor. The use of unlicensed subcontract labor for installation or submittal preparation is prohibited.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but not less than 1 unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but not less than 1 unit.
3. Smoke, and Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but not less than 1 unit of each type.
4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but not less than 1 unit of each type.
5. Keys and Tools: One extra set for access to locked and tamperproofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. FACP and Equipment:
      a. Notifier
      b. Edwards System Technology
      c. Siemens Building Technologies, Inc.
   2. Wire and Cable:
      a. Comtran Corporation.
      b. Helix/HiTemp Cables, Inc.; a Draka USA Company.
      c. Rockbestos-Suprenant Cable Corporation; a Marmon Group Company.
      d. West Penn Wire/CDT; a division of Cable Design Technologies.
   3. Audible and Visual Signals:
      a. Notifier (no substitutions)

2.2 FACP

A. General Description:
   1. Modular, power-limited design with electronic modules, UL 864 listed.
   2. Addressable initiation devices that communicate device identity and status.
      a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at the FACP.
      b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
   3. Addressable control circuits for operation of mechanical equipment.
   4. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted deceptive nuisance alarms.
   5. Each detector shall have an integral microprocessor capable of making alarm decisions based on fire parameters stored in detector head. Detectors not capable of making ndependent alarm decisions shall not be acceptable. Maximum total analog loop response shall be 0.5 seconds.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
   1. Annunciator and Display: The main display status shall be on an 8 line 21 character backlit alpha-numeric liquid Crystal display.
   2. Keypad: Arranged to permit entry and execution of programming, display, and control commands; and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Circuits:
   1. Signaling Line Circuits: NFPA 72, Class A.
      a. System Layout: Install no more than 50 addressable devices on each signaling line circuit.
   2. Notification-Appliance Circuits: NFPA 72, Class A.

D. Smoke-Alarm Verification:
   1. Initiate audible and visible indication of an "alarm verification" signal at the FACP.
   2. Activate a listed and approved "alarm verification" sequence at the FACP and the detector.
   3. Record events by the system printer.
   4. Sound general alarm if the alarm is verified.

5. Cancel FACP indication and system reset if the alarm is not verified.

E. Notification-Appliance Circuit: Operation shall sound in a temporal pattern, complying with ANSI S3.41.

F. Power Supply for Supervision Equipment: Supply for audible and visual equipment for supervision of the ac power shall be from a dedicated dc power supply, and power for the dc component shall be from the ac supply.

G. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACP and remote annunciators, after initiating devices are restored to normal.
   1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
   2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
   3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.

H. Walk Test: A test mode to allow one person to test alarm and supervisory features of initiating devices. Enabling of this mode shall require the entry of a password. The FACP and annunciators shall display a test indication while the test is underway. If testing ceases while in walk-test mode, after a preset delay, the system shall automatically return to normal.

I. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and control of changes in those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and make a print-out of the final adjusted values on the system printer.

J. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, trouble, and supervisory signals to a remote alarm station through a digital alarm communicator transmitter and telephone lines.

K. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signal, supervisory and digital alarm communicator transmitter shall be powered by the 24-V dc source.
   1. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the power-supply module rating.
   2. Power supply shall have a dedicated fused safety switch for this connection at the service entrance equipment. Paint the switch box red and identify it with "FIRE ALARM SYSTEM POWER."

L. Secondary Power: 24-V dc supply system with batteries and automatic battery charger and an automatic transfer switch.
   1. Batteries: plate nickel cadmium.
   2. Battery and Charger Capacity: Comply with NFPA 72.

M. Surge Protection:
   1. Install surge protectors recommended by FACP manufacturer. Install on all system wiring external to the building housing the FACP.

2.3 MANUAL FIRE ALARM BOXES

A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.
   1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP. Pull station shall be EST Model SIGA-278 or equal.
   2. Station Reset: Key-operated switch.
   3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation. Cover shall be Stopper ST1-1000
   4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm.

2.4 SYSTEM SMOKE DETECTORS

A. General Description:
   1. UL 268 listed, operating at 24-V dc, nominal.
   2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
   3. Multipurpose type, containing the following:
      a. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
      b. Piezoelectric sounder rated at 88 dBA at 10 feet (3 m) according to UL 464.
      c. Heat sensor, combination rate-of-rise and fixed temperature.
   4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection of building wiring.
   5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
   6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.
   7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.
      a.

B. Photoelectric Smoke Detectors:
   1. Sensor: The analog photoelectric detector shall utilize a light scattering type photolelectric smoke sensor to sense changes in air samples from its surroundings. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. The detector shall continually monitor any changes in sensitivity due to the environmental affect of dirt, smoke, temperature, aging and humidity. The information shall be stored in the integral processor and transferred to tht analog loop controller for retrieval using a PC. The photo detector shall be rated fro ceiling installation. The phoelectric smoke detector shall also be suitable for direct insertion into ducts with velocity of up to 5000 ft/min without requiring specific duct detector housings or supply tubes.
   2. Detector Sensitivity: Between 1.0% and 3.5 percent/foot smoke obscuration when tested according to UL 268A.
   3. Photoelectric Smoke Detectors shall be EST Model SIGA-PS or approved equal.
   4. Standard detector bases shall be EST Model SIGA-SB/SIGA-SB4.
   5. The base shall be capable of supporting one EST Model SIGA-LED remote LED. The remote LED shall be furnished and installed where the smoke detector is not visible from the floor area around the air conditioning duct.

C. Duct Smoke Detectors:
   1. Duct Smoke Detectors:
      a. Sensor: The analog photoelectric detector shall utilize a light scattering type photolelectric smoke sensor to sense changes in air samples from its surroundings.
      b. Detector Sensitivity: Between 0.5 and 1.7 percent/foot (0.0016 and 0.0056 percent/mm) smoke obscuration when tested according to UL 268A.
      c.
   2. UL 268A listed, operating at 24-V dc, nominal.
   3. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.
      a. Weatherproof Duct Housing Enclosure: UL listed for use with the supplied detector. The enclosure shall comply with NEMA 250 requirements for Type 4X.
   4. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
   5. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status. Provide remote status and alarm indicator and test station where indicated.

D. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP
   1. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
   2. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.
      a. Weatherproof Duct Housing Enclosure: UL listed for use with the supplied detector. The enclosure shall comply with NEMA 250 requirements for Type 4X.

2.5 NOTIFICATION APPLIANCES

A. Description: Equipped for mounting as indicated and with screw terminals for system connections.
   1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.

B. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output. As required to meet ADA requirements.

C. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output. As required to meet ADA requirements.

D. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn.

E. Visible Alarm Devices: Xenon strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
   1. Rated Light Output: 75 candela.
   2. Strobe Leads: Factory connected to screw terminals.

2.6 SPRINKLER SYSTEM REMOTE INDICATORS

A. Remote status and alarm indicator and test stations, with LED indicating lights. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single-gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

2.7 REMOTE ANNUNCIATOR

A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, resetting, and testing.
   1. Mounting: Flush cabinet, NEMA 250, Class 1.

B. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

2.8 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module listed for use in providing a system address for listed alarm-initiating devices for wired applications with normally open contacts. It shall be possible to address each module without the use of DIP or rotary switches. The multifunction modules shall be programmable at site to suit conditions and may be changed at any time using a code downloaded from the Analog Loop Controller. Modules requiring EPROM, Prom, ROM changes or DIP switches will not be acceptable. A green LED shall flaxh to confirm communication with the loop controller. A red LED shall flash to display alarm status.

2.9 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Listed and labeled according to UL 632.

B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically captures one or two telephone lines and dials a preset number for a remote central station. When contact is made with the central station(s), the signal is transmitted. The unit supervises up to two telephone lines. Where supervising 2 lines, if service on either line is interrupted for longer than 45 seconds, the unit initiates a local trouble signal and transmits a signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. When telephone service is restored, unit automatically reports that event to the central station. If service is lost on both telephone lines, the local trouble signal is initiated.

C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.

D. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.10 GUARDS FOR PHYSICAL PROTECTION

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection mount over gymnasium devices.
   1. Factory fabricated and furnished by manufacturer of the device.
   2. Finish: Paint of color to match the protected device.

2.11 WIRE AND CABLE

A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, not less than No. 16 AWG.
   1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70 Article 760, Classification CI, for power-limited fire alarm signal service. UL listed as Type FPL, and complying with requirements in UL 1424 and in UL 2196 for a 2-hour rating.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
   1. Low-Voltage Circuits: No. 16 AWG, minimum.
   2. Line-Voltage Circuits: No. 12 AWG, minimum.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Smoke or Heat Detector Spacing:
   1. Smooth ceiling spacing shall not exceed 30 feet.
   2. Spacing of heat detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas, shall be determined according to Appendix A in NFPA 72.
   3. Spacing of heat detectors shall be determined based on guidelines and recommendations in NFPA 72.

B. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.

C. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of the duct.

D. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

E. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

F. Visible Alarm-Indicating Devices: Install adjacent to each alarm horn and at least 6 inches (150 mm) below the ceiling mount at maximum of 80”.

G. Device Location-Indicating Lights: Locate in public space near the device they monitor.

H. FACP: Surface mount with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

I. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.

J. Pull stations shall be at ADA recommended heights.

3.2 WIRING INSTALLATION

A. Wiring Method: Where exposed to damage such as mechanical rooms and gymnasium. Install wiring in metal raceway according to Division 16 Section "Raceways and Boxes."
   1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.

B. Wiring Method:
   1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
   2. Fire-Rated Cables: Use of 2-hour fire-rated fire alarm cables, NFPA 70 Types MI and CI, is permitted in interior areas and not exposed to damage.
   3. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or raceway as signaling line circuits.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

F. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Division 16 Section "Electrical Identification."

B. Install instructions frame in a location visible from the FACP.

C. Indicate breaker in panel as fire alarm per NFPA.

3.4 GROUNDING

A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
   1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.
   2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters. All tests shall be conducted under the direct supervision of a NICET technician certified under the Fire Alarm Systems program at Level III.
   3. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
   4. Testing: Follow procedure and record results complying with requirements in NFPA 72.
   5. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.6 ADJUSTING

A. Follow-Up Tests and Inspections: After date of Substantial Completion, test the fire alarm system complying with testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for three monthly, and one quarterly, periods.

B. Semiannual Test and Inspection: Six months after date of Substantial Completion, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

C. Annual Test and Inspection: One year after date of Substantial Completion, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, semiannual, and annual periods. Use forms developed for initial tests and inspections.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Refer to Division 1 Section Closeout Procedures.

END OF SECTION 283111

SECTION 283113 - LIGHTING CONTROL CABLING

PART 1 GENERAL

1.1 PROJECT SUMMARY/OVERVIEW

A. The communication cabling contactor is to provide a complete communications cabling infrastructure system installation including but not limited to: Copper backbone/riser system w/secondary protection, horizontal data cabling with Quick port terminations, mounting equipment, cable pathway and management systems, testing and other items/materials, as specified in drawings, these specifications, and contract documents.

B. The items described herein shall not be substituted without the written consent of Halff Associates (consultant).

C. Communications Cabling Contractor shall be herein after referred to as Contractor for the scope of this document.

D. Contractor shall be responsible for all written specifications and drawings that correspond to this project.

E. These specifications are intended for bidding purposes only. No part shall be copied or used for any purpose other than bidding on this project.

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including Uniform General Conditions, Supplementary General Conditions, Architectural Plans and Specifications, requirements of Division 1, electrical, mechanical specifications and plans, and Telecommunications plans apply to the Telecommunications section and shall be considered a part of this section. The contractor shall read all sections in their entirety and apply them as appropriate for work in this section.

B. In order to accomplish the conditions of this agreement, the contractor shall perform the specific duties listed herein.

C. Contract Documents: Drawings and specifications are to be used in conjunction with one another and to supplement one another. In general the specifications determine the nature and quality of the materials, and the drawings establish the quantity guidelines, details, and give characteristics of performance that should be adhered to in the installation of the communications system components. If there is an apparent conflict between the drawings and specifications, the items with the greater quantity or quality shall be estimated upon and installed. Clarification with the owner about these items shall be made prior to the ordering and installation.

D. Insurance: Prior to commencing work the Contractor shall procure at their own cost and expense insurance against claims for injuries to persons or damages to property by the Contractor, its agents, officers, employees, or subcontractors that may arise from or in connection with the performance of this Agreement. The policies will be available for review by the owner or consultant at any time during the agreement. These insurance policies shall be maintained and remain in full effect for the entire term of agreement.

E. Project and cost payment: Refer to general contractor contract documents and/or master specifications issued by architect.

F. Contractor will respect and protect the privacy and confidentiality of Owner, its employees, processes, products, and intellectual property to extent necessary, consistent with the legal responsibilities of the State of Texas and Owner policies.

G. Contractors shall sign a non-disclosure agreement and abide by the requirements to keep confidential all information concerning bid documents and this project

H. Use of subcontractors: Bidding contractors shall inform owner’s contact and General Contractor in writing about the intention to use subcontractors and the scope of work for which they are being hired. Owner must approve the use of subcontractors in writing or owner’s designated contact prior to the subcontractor’s hiring and start of any work.

I. Contractor shall designate their project manager as the single point of contact and shall provide the name phone number and electronic mail information for the designated person. Project manager shall oversee all work performed to insure compliance with specifications as outlined in bid documents (which includes all specifications and drawings) to insure a quality installation.

1.3 SCOPE OF WORK

A. Contractor to comply with the master specifications documents and following requirements for a complete project installation.

B. This section establishes a communications infrastructure to be used as signal pathways for high-speed data transmission for network lighting control system. Provide a structured cabling system as indicated on plans for control of lighting.

C. Furnish all labor, materials, tools, equipment and services for the installation described herein. All requirements and specifications will be enforced. All cable pathways and runs to individual outlets are not shown in their entirety but shall be provided as if shown in their entirety. Where not specifically noted the contractor shall determine exact routing.

D. Installation procedures for communications cable will be such that the mechanical and electrical transmission characteristics of the specified cable plant and equipment are maintained.

E. Work of this Section covers a complete installation of both permanent and channel links for a Data Network utilizing copper media that includes, but is not limited to the following:

1. Installation and termination of secondary fused Building Entrance Terminals (BET's) for protection of incoming Service provider or campus inter-building copper pair circuits. All copper pairs entering the building from an outside distribution network will be fuse protected.

2. Provide, install, terminate, test, and document all copper backbone and riser cable.

3. Provide, install, terminate, test, and document all copper data horizontal cable.

4. Provide and place all termination devices such as but not limited to: Modular patch panels, termination blocks, information outlets, and distribution panels.

5. Provide, in quantities specified, interconnect components such as but not limited to: cross connect wire, copper cables.

6. Provide and place horizontal and vertical cable support devices such as but not limited to: J-hooks, Cable saddles, and all required mounting hardware, unless otherwise noted.

7. Provide and install approved fire-stopping systems in all communication pass-through

spaces, conduit and cable tray wall and floor penetrations. Fire stop systems will be coordinated with General Contractor/Architect.

8. Provide complete documentation and demonstration of work.

9. Resolution of all punch list deficiencies within 10 working days.

10. Provide organized complete 100% Test Results of all copper and fiber cable and their components.

11. Produce final drawings of record.

12. The Owner may separately purchase and/or provide certain equipment and miscellaneous items that will be installed during the course of trim work. Such items may not be indicated in the Documents. Contractor shall cooperate with the Owner and his Suppliers.

13. The furnishing and installation of computer hardware and related networking software and equipment.

1.4 WORKS AND MATERIAL BY OTHERS (NIC) INCLUDE:

A. The Telecommunications Grounding Buss bars and grounding conductors connecting to main building electrode system to be provided on this project by Division 26 00 00.

B. The dedicated electrical power panels, isolated/non-isolated, emergency circuits and utility outlets to be provided by Division 26 00 00.

C. The furnishing, installation and finishing of plywood backboards to be provided by others. (Div.26000) Plywood installation will be coordinated with the General Contractor/Architect.

D. Building mechanical ductwork, HVAC system, and environmental control sensors to be provided by others.

E. The communication pathway devices such as, but not limited to: cable tray, flex tray, conduits, conduit sleeves, and wall and floor penetrations in corridors, office spaces, and open areas to be provided by Division 26 00 00.

1.5 STAFFING

A. Qualification: Submit an up-to-date and valid certification verifying the qualifications of the Contractor and installers to perform the work specified herein at time of bid submission.

B. Contractor shall have a complete working knowledge of low voltage cabling applications such as, but not limited to: data, voice and video network systems.

C. Contracting firm shall have installed similar systems in at least (10) other projects in the last five years prior to this bid and be regularly engaged in the business of installation of the types of systems specified in this document. Contractor shall provide information on prior projects including, but no limited to: items such as name and location of project contacts and numbers, total square footage, total number of cables/drops, types of media, etc.

D. All installer personnel assigned to this project shall be listed in the qualification questionnaire document. Eighty percent (80)% shall have a minimum of 3 years experience in the installation of the types of systems, equipment, and cables specified in this document prior to this bid. Any personnel substitutions shall be noted in writing to Halff Associates prior to commencement of work.

E. Contractor shall submit evidence of compliance with these requirements prior to beginning work on the project.

F. Cabling installers shall be trained by the manufacturer and certified for Telecommunication Cabling installations and maintenance of specified materials.

1.6 ADMINISTRATIVE REQUIREMENTS AND COORDINATION

A. Project meetings: Contractor shall provide a person (name, contact phone number and e-mail address) for coordination with Telecommunication Consultant and Owner.

B. Coordinate work of this section with Owner’s telephone system specifications, telephone instruments, workstations, equipment suppliers, and installers.

C. Coordinate installation work with drop ceiling vendors to coordinate cabling installation time frame in relation to drop ceiling installation. Resolve procedures and installation sequence for both installations. The result of this coordination will be to eliminate as much as possible loss or

damage to ceiling materials, associated hardware, and delays to the project. Damage by contractor to the ceiling installation will be remedied at the contractor's expense in a timely manner.

D. Exchange information and agree on details of equipment arrangements and installation interfaces.

E. Record agreements reached in meetings and distribute record to other participants, Owner and Telecommunication Consultant.

H. When requested by owner or owner's representative furnish extra materials that match specified products and that are factory packaged with protective covering for storage and identified with labels describing contents.

1.7 CONTRACT ADMINISTRATION

A. Change orders shall be submitted to the consultant/client representative or GC complete with price breakdown and description. No work related to any change order will commence until approved.

B. The Contractor will attend all scheduled progress meetings with Owner representative, Architect, Telecommunication Consultant and General Contractor. It is possible that all parties may not be represented at every meeting.

1.8 PERMITS AND LICENSE

A. Contractor shall supply all State, City and County Telecommunication Cabling Permits required by appropriate governing agency.

B. Contractor shall be State Licensed and/or bonded for Telecommunication Cabling Installation and to comply with the State of Texas requirements.

C. The Owner or their representative will verify the above and determine any additional requirements.

1.9 ALTERNATES, SUBSTITUTIONS AND CHANGE ORDERS

A. If the Contractor proposes an alternate material that is equal to or exceeds specified requirements, Contractor shall provide manufacturer's specifications in writing to Engineer for approval 10 days prior to bid date. Notification of approved alternates will be issued by addenda.

B. Contractor shall provide a complete cabling infrastructure according to these written specifications and drawings. If the Owner changes the scope of work to be performed by the Contractor, it shall be in writing. Contractor shall respond to these changes with a complete material list, labor, and taxes in writing presented to the Owner for approval within ten (10) working days. Contractor shall not proceed with additional scope of work without a signed approval by the Owner.

C. Owner will not pay for any additional work performed by the Contractor without signed approval of these changes. Submit a copy of signed change order upon billing.

D. A complete price breakdown itemizing all additional material and labor costs shall be submitted to the owner/consultant with the change order.

1.10 CODES AND STANDARDS (REFERENCES):

A. Codes: Comply with applicable sections of the following for interior and exterior installations. Ensure you are using the latest and most current standards and regulations applicable.

Uniform Building Code (UBC)

International Building Code (IBC)

National Electrical Code (NEC/NFPA 70, 2008)

National Electrical Safety Code (NES IEEE C2-1997)

IEEE Std. 1100-1999 Recommended Practice for Powering and Grounding Sensitive Electronic equipment.

Local Codes, amendments, and ordinances.

B. Standards: Comply with the most recently published applicable sections of the following for installation and testing of communication cabling and connectors:

ANSI/TIA/EIA-568-B.1-2001: Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.

ANSI/TIA/EIA-568-B.2-1-2002: Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.

ANSI/TIA/EIA-568-B.3-2001 Part 3: Optical Fiber Cabling Components Standard.

ANSI/TIA/EIA-455-A-1991: Standard Test Procedures for Fiber Optic Cables.

ANSI/CEA S83-596-1994: Fiber Optic Premises Distribution Cable.

ANSI/TIA/EIA-526-7-1998: Optical Power Loss Measurements of Installed Single Mode Fiber Cable Plant-OFSTP-7.

ANSI/TIA/EIA-526-14-A-1998: Optical Power Loss Measurements of Installed Multi Mode Fiber Cable Plant-OFSTP-14A.

ANSI/TIA/EIA-569-A-1998: Commercial Building Standards for Telecommunications Pathways and Spaces.

ANSI/TIA/EIA-606-1993: The Administration Standard for the Telecommunications infrastructure of Commercial Building.

ANSI/TIA/EIA-607-1994: Commercial Building Grounding and Bonding Requirements for Telecommunications.

TIA/EIA 758-April 1999: Customer-Outside Plant Telecommunications Cabling Standard.

C. Supervisors and lead installers shall have read the above documents and shall be familiar with the requirements that pertain to this installation. Installers shall be familiar with and have practical working knowledge of the requirements that pertain to this installation. The documents may be

obtained from:

1. Global Engineering Documents, 15 Inverness Way East, Englewood, CO, 80112-5776, 800-854-7179, fax: 303-397-2740, http://global.his.com/

   IEEE-Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY, 10017-2394, 800-678-IEEE, fax: 732-981-9667, http://standards.ieee.org/

2. NFPA: 1-800-344-3555- 11 Tracy Drive, Avon, MA 02322-9908

1.11 COMMUNICATIONS ABBREVIATIONS

BICSI: Building Industry Consulting Service International

C/W: Complete With.

CBC: Coupled Bonding Conductor

Div.1: Division 1 General Specifications

Div.23: Division 23 Mechanical Specifications

Div.26: Division 26 Electrical Specifications

EMI: Electromagnetic Interference.

GC: General Contractor

HC: Horizontal Cross-Connect.

IC: Intermediate Cross-Connect.

IDC: Insulation Displacement Connector.

I/O: Information Outlet.

LAN: Local Area Network.

MC: Main Cross-Connect.

MDF: Main Cross-Connect (MC).

N/A: Not Applicable.

NIC: Not In Contract.

OTDR: Optical Time Domain Reflectometer

RCDD: Registered Communications Distribution Designer

RFI: Radio Frequency Interference.

SR: Server Room

TBB: Telecommunications Bonding Backbone.

TBBIBC: Telecommunications Bonding Backbone Interconnecting Bonding Conductor

TBC: Telecommunications Bonding Conductor.

TBD: To Be Determined

TGB: Telecommunications Ground Bus Bar.

TMBC: Telecommunications Main Bonding Conductor.

TMGB: Telecommunications Main Grounding Bus Bar.

TR: Telecommunications Room.

UTP: Unshielded Twisted Pair.

1.12 SUBMITTALS:

A. Product Data: Include Manufacturer's data on features, ratings and performance for each component specified for approval prior to purchase and installation.

B. Drawings of Record: Shall be in AutoCAD format same version used by Architect/Consultant. Upon completion, submit facility floor plan drawings to consultant and/or owner upon request. Dimensions and scale of the drawing sheets submitted shall match the size of the drawing used for the contract documents, and shall include the following:

C. Dimensioned plan and elevation views of networking components including, but not limited to: outlet and raceway location, roughing-in diagrams and instructions for installation. Show access and workspace requirements.

1. One-line diagram of equipment/device interconnecting cabling for the data systems.

2. Standard or typical installation details of installations unique to Owner's requirements.

3. Submit one soft and one hard copy with project deliverables within 30 days of substantial completion.

D. Graphic symbols and component identification on detail drawing shall conform to the latest EIA/TIA 568-B, 606 and 607 conventions.

E. System labeling schedules, including electronic copies of labeling schedules, as specified below, in software and format selected/approved by Owner.

F. Samples: For two port quick connect outlets, jack assemblies, housing and faceplates for color selection and evaluation of technical specifications and requirements. Confirm with architect/interior designer/Owner representative for color before purchasing materials.

G. Product Certificates: Signed by manufacturer of cables, connectors, and terminal equipment certifying that products furnished comply with requirements.

H. Qualification Data: For firms and persons specified in "Quality Assurance" article. Provide evidence of applicable registration or certification.

I. Field Test Reports: Upon completion and testing of the installed system, test reports shall be submitted in booklet form and electronic media showing all field tests performed on, and adjustments to each/any component and all field tests performed to prove compliance with the specified performance criteria. Indicate and interpret test results in written form and verbally to Owner for compliance with performance requirements.

J. Contractor will provide maintenance data and manuals for: all products.

K. Warranty: Deliver manufacturer's sample of 15-year warranty of installed cabling system to include all components that comprise the complete cabling system.

1.13 RESUBMITTING

A. Contractor must clearly identify any resubmitted drawing sheets, documents or cut sheets either by using a color to highlight or cloud around resubmitted information. Maintain drawing numbering or page/sheet scheme consistency as per previously issued drawings/documents.

1.14 RECORDING AND COPYING TO DRAWINGS OF RECORD (AS-BUILT DRAWINGS)

A. The build-as drawings shall be developed from AutoCAD (version 2011) drawing files of Communications Design drawings to be supplied by Halff Associates or the Architect.

B. As-built drawing submittals by the Contractor shall be in the same version AutoCAD format, as used by architect and consultant. Unless otherwise specified. This requirement currently is AutoCAD 2011.

C. The As-built drawings shall incorporate all changes made to the building identified in, but not limited to: Addendum, contemplated change notices, Site Instructions or deviations resulting from site conditions. Utilize normal recognized drafting procedures that match the AutoCAD standards, architect, and consultant guidelines and methodology. The Contractors as-built submittals shall include but not be limited to:

D. All communications data outlet locations complete with outlet/cable labeling.

E. Cable routing paths of communications cables to identified infrastructure pathways.

F. All rack and cabinet locations and labeling thereof.

G. All plan or elevation view changes to the MC/TR layouts.

H. Wall Field and patch panel layouts and cable assignments.

1.15 PRE-INSTALLATION CONFERENCE:

A. Contractor will attend and/or arrange a scheduled pre installation conference prior to beginning any work of this section (Data cabling).

B. Requests For Information (RFI): Contractor will submit questions in writing related to work to be performed, scheduling, coordination, etc. with consultant and/or project manager/owner representative.

C. Attendance: Contractors project manager/supervisor shall attend all meetings arranged by General Contractor, Owner's representatives, and other parties affected by work of this division 26 00 00.

D. All individuals who will be in an on-site supervisory capacity of installation personnel; project managers, supervisors and lead installers shall be required to attend the pre-installation conference. Individuals who do not attend the conference will not be permitted to supervise the installation of, or install, terminate, or test communications cables on the project.

1.16 DELIVERY/STORAGE AND HANDLING

A. Delivery, Loss, Storage, and Protection: All materials and equipment delivered and placed in storage shall be stored with protection from the weather, humidity, and temperature variation, dirt, dust, or other contaminants.

B. Coordinate deliveries and submittals with the Prime Contractor to ensure an organized timely installation.

C. Contractor shall be responsible for all handling and control of equipment. Contractor is liable for any material loss due to delivery and storage problems.

D. No equipment materials shall be delivered to the job site more than three weeks prior to the commencement of its installation. Coordinate with Prime Contractor on location for storage of materials.

1.17 PRODUCT STORAGE REQUIREMENTS AND SITE ACCESS

A. Owner/General Contractor will assign a location or room to store telecommunication materials.

B. Contractor is ultimately/exclusively responsible for loss and/or damage to materials.

C. Contractor will have access to this site between the hours of 7am to 5pm. Monday thru Friday.

D. Extended work hours: If the Contractor desires to work after hours or weekends, Contractor shall provide a work schedule complete with dates, times, and individuals names to the Owner/General Contractor for approval.

E. Contractor will comply with provisions of Owner/General Contractor supplied list of job site security requirements.

1.18 PROJECT/SITE CONDITIONS

A. For all environmental recommendations, Refer to Master Architectural section.

B. For all security recommendations, Refer to Owner/General Contractor.

C. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

D. Contractor shall provide a clean work environment, free from trash/rubbish accumulated during and after cabling installation. Work area will be cleaned daily.

E. Contractor shall keep all liquids (drinks, Sodas, etc.) off finished floors, carpets, and tiles. If any liquid damages finished surfaces, Contractor shall provide professional service to clean or repair

scratched/soiled finishes at their own expense.

1.19 SCHEDULING

A. Construction schedule will be determined on a later date by General Contractor/Architect/Owner and/or communication consultant. Refer to master Architectural specifications.

1.20 ACCEPTANCE

A. Once all work has been completed, test documentation has been submitted, and Owner is satisfied that all work is in accordance with contract documents, the Owner shall notify contractor in writing of formal acceptance of the system.

B. Contractor must warrant in writing that 100% of the installation meets the requirements specified herein (Standards Compliance & Test Requirements).

C. Notification of the likelihood of a cable exceeding standardized lengths must be made prior to installation of the cable. Designer/consultants and Owners may agree to allow certain cabling runs to exceed standardized performance criteria (e.g. length). If it is decided to allow the designated cable to exceed standardized lengths, such runs shall be explicitly identified and excluded from requirements to pass standardized tests. Tests for wire mapping, open, shorts, and grounds shall be made if other tests are waived.

D. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation soft and hard copies as described herein.

PART 2– PRODUCTS

2.1 WARRANTY AND CONDITIONS:

A. Contractor shall provide a minimum one (1) year warranty on installation and workmanship.

B. All materials are to be new and unused.

C. Pre-installation inspection:

1. Visually inspect all cables, cable reels, and shipping cartons to detect possible cable damage incurred during shipping and transport. Visibly damaged goods are to be returned to the supplier and replaced at no additional cost to the Owner.

D. All Contractors must be Manufacturer Certified and employ installers capable of an installation that falls under Manufacturer's guidelines necessary to obtain a minimum15-year Manufacturer's Warranty.

2.2 ACCEPTABLE MANUFACTURERS:

A. Only manufactures offering certified partnered system solutions for structured cabling, that carry a full manufacturer warrantee will be accepted.

B. Products:

1. Campus Copper Backbone (indoor/outdoor rated PE rated 23AWG):
    a. Panduit
    b. Leviton

2. Horizontal Category 5e UTP, Plenum Rated, green in Color (Network Lighting Controls)
    a. Panduit
    b. Leviton

3. Above Ceiling Cable Supporting Hardware.
    a. Panduit or equal.

4. Labeling:
    a. Horizontal cabling: Panduit or equal.
    b. UTP Patch panels: Panduit or equal.
    c. Riser Cabling: Panduit or equal.
    d. Conduits/Trays: HellermannTyton or equal.

5. Corridors and other areas as indicated on drawings.
   (No more than twenty-four-4 pair UTP Category 5e cables shall be installed in each J-hook)

a. Panduit
b. Erico

6. Fire Stop systems (All Wall Sleeves)
    a. Specified Technologies Inc. (SPI-Easy Path Products)

7. Grounding bus bars:
    a. Harger BICSI Pattern Telecommunications Ground Bar Kits
    b. Chatsworth BICSI & ANSI/EIA/TIA Grounding Bus-bars

2.3 IDENTIFICATION PRODUCTS:

A. Cable Labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.

B. Provide transparent plastic label holders and 4-pair marked colored labels.

C. Install colored labels according to the type of field as per TIA/EIA color code designations.

D. Use TIA/EIA designation strip color-code guidelines for voice, data, cross-connect, riser, and backbone fields.

2.4 FIRE STOP PROCEDURES:

A. Provide fire resistant intumescent materials to restore fire ratings to all wall, floor or ceiling penetrations used in the distribution and installation for this communications cabling system.

B. Seal all penetrations through fire-rated barriers created by or made for or on behalf of the contractor to prevent the passage of smoke, fire, toxic gas, sound or water through the penetrations either, before, during or after a fire.

C. Fire stop materials shall be installed per manufacturer’s instructions, be UL listed for intended use, and meet current NEC and local codes for fire stop measures.

D. The fire stop material chosen shall be distinctively colored to be clearly distinguishable from other

materials, adhere to itself, and remain resilient and pliable to allow for the removal and/or addition of cable without the necessity of drilling holes in the material.

E. Provide and install removable, intumescent, fire-stop pillows in an approved fashion in all openings greater than 4 inches.

F. Provide and install manufacturer-approved methods for securing pillows.

G. Coordinate fire stop material, methods of installation, installation schedule, color, etc. with general contractor and electrical contractor on site.

H. Fire Stop Labeling: The contractor shall label each fire-stopped penetration with the following typical label;

!! WARNING!!
_____ Hour Rating
FIRE STOP SEAL
DO NOT DISTURB

NAME OF CONTRATORS COMPANY: PHONE# -_____
INSTALLER - _____ DATE - _____
SUPERVISOR - _____ DATE - _____

2.5 ACCESSORIES

A. The Contractor shall mount one hard copy, in color, 36”w x 24”h of a floor plan, clear plastic laminated, serving each communication room. Install the One-line drawings within a protective Plexiglas encasement on the wall of the servicing MC/TR/IC rooms. The Plexiglas encasement shall be in either flip-down format or file folder format for ease accessibility.

2.6 TEST RESULTS AND AS-BUILTS:

A. Contractor shall provide test results in soft copy for each cable with the date and time of testing shown. Copies shall be provided on CD. Copies shall be in MsOffice97/2000 spreadsheets.

B. Provide a minimum of two (2) hard copies of the above mentioned test results.

C. Contractor shall submit the approved and complete master “As-Built” drawing package in both hard and soft copies to the Owner and Halff Associates. The copies shall be in the same release of AutoCAD as provided by consultant and shall comply with drawing symbols, text styles, layering standards, drawing practices, etc. as set forth in consultant supplied files.

D. Provide a minimum of two (2) hard and soft copies of the As-Builts.

2.7 QUALITY CONTROL

A. Materials: All materials shall be UL and/or ETL approved and labeled in accordance with NEC for all products where labeling service normally applies.

B. Materials and equipment requiring UL 94, 149 or 1863 listing shall be so labeled. Modification of products that nullifies UL labels is not permitted.

C. All material and equipment as provided should be the standard Commercial-Off-The-Shelf (COTS) products of a manufacturer engaged in the manufacturing of such products. All shall be typical commercial designs that comply with the requirements specified. All material and equipment shall be readily available through manufacturers and/or distributors.

D. All equipment shall be standard catalogued items of the manufacturer and shall be supplied complete with any optional items required for proper installation.

E. Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections of optimum future performance and backward compatibility.

F. Expansion Capability: Unless otherwise indicated, provide spare conductor pairs in cables, positions in patch panels, cross connects, and terminal strips, and space in cable pathways and backboard layouts to accommodate 20 percent future increase in campus distribution and active workstations.

G. Backward Compatibility: The provided solution shall be backward compatible with lower category ratings such that if higher category components are used with lower category components, the basic link and channel measures shall meet or exceed the lower channel's specified parameters.

H. Component Compliance: The provided solution's components shall each meet the minimum transmission specifications listed herein such that no individual component will be less than specifications for permanent link and channel, regardless of the fact that tests for link and channel ultimately meet required specifications.

I. In the event of a breach of the representations and warranties contained herein, the Contractor, at their own expense, shall take all measures necessary to correct and make the cabling system work in compliance with the applicable manufacturer written technical recommendations and standards.

PART 3– EXECUTION

3.1 OBJECTIVE

A. The objective of this agreement is to provide a complete network lighting control communications system cabling infrastructure installation for backbone, riser, cable protection, and horizontal data wiring with two-port quick connects, mounting equipment, materials, testing and other items as specified in drawings, these specifications, and contract documents.

B. COORDINATION AND COMPLIANCE

1. Contractor shall coordinate lighting control bridges locations etc. with the architectural, electrical, and mechanical consultant drawings/documents before installation.

2. Contractor shall call for any inspections required by public agencies having jurisdiction in the area. Final payment of this contract will not be made until final inspections have been completed and all deficient items noted have been corrected.

3. The Contractor shall be responsible for complying with all local, state and federal laws or regulations applicable to the work to be performed, although said law; rule or regulation is not identified herein.

4. The contractor is responsible for any remaining construction materials; refuse within the area of work, and daily cleaning of the work area.

5. The Contractor will cooperate and coordinate with General Contractor and owner's representative to ensure the timely progress of all work.

6. Coordinate items or equipment components related to this project provided by the owner. Refer to section "Work and Material by Others" Items furnished by owner, installed by contractor:

7. Contractor shall be responsible for coordination with all trades, to include required scheduling of materials and/or equipment with Owner or general contractor for delivery and protection of equipment as required.

8. Refer to manufacturer's installation specifications and procedures for work to be accomplished by Contractor. The installation of cable, equipment, and materials will conform to manufacturer's specification to insure manufacturer's full warranty is in effect.

9. Contractor shall be responsible for review of all drawings of record to verify service requirements for proper installation of items.

10. The Contractor shall assume custody and responsibility for the items upon delivery and for determining that the contents are complete and in satisfactory condition for installation.

11. Remove all redundant (other) items from site at Contractor's expense.

12. Report percentage of work completed on a weekly basis.

3.2 EXAMINATION

A. Examination of building and site shall be the responsibility of the Contractor: Contractors shall examine site and building as required prior to quoting to determine any conditions affecting the work. Contact Owner for arrangements.

3.3 CABLE PLANT OVERVIEW

A. Contractor shall provide all labor and material for a complete lighting control system.

B. Bridges, gateways, two port quick connects, ceiling mounted copper patch panels and light switch locations I/O: Category 5e

3.4 COPPER PATCH CORDS

A. Copper: Provide equal amounts of green 5 foot Category 5e patch cables for 75% of the terminated horizontal data cables in the telecommunications rooms. Patch cables shall be from the same manufacturer as the structured cabling system.

3.5 INTERIOR COMMUNICATION PATHWAYS

A. Cables shall be neatly bundled along common paths. Maximum number of cables per bundle shall be determined by supporting hardware manufacturer recommendations.

B. Use only pathway and spaces designed for telecommunications.

C. Provide a minimum of 20% spare capacity in all vertical/horizontal chases.

D. Mechanical and power separation. Install communications cabling:

1. Minimum of 3 feet from electrical panel boards, photocopier.

2. Minimum of 6 inches from fluorescent fixtures

3. Minimum of 6 feet from electrical motors.

3.6 CONDUITS

A. All lighting control switch outlets shall have a minimum of one 1” conduit provided from the recessed deep box to ceiling attic. Furnish and install lighting control communication cabling separated from 120/277 volt current carrying conductors. Contractor shall furnish and install each cabling in separate conduits.

B. There shall be a maximum of two (2) 90° degree bends per conduit run, between any two adjacent pull boxes.

C. No conduit run shall exceed 100 feet between pull boxes.

D. Division 26 00 00 shall provide conduit path (sleeves) where cabling passes through fire rated walls\deck\slab. Seal penetration with intumescent fire-stop material that matches the rating of the surface penetrated. Coordinate fire stopping with Division 26 00 00 and general contractor on site.

E. Division 26 00 00 shall secure conduit sleeves with minimum 12” long “Uni-strut” or equivalent (support) channel at both sides of wall. Complete installation with “Uni-strut” or equivalent conduit retaining straps sized for the conduit being installed.

F. Division 26 00 00 in coordination with architect and general contractor shall provide accessible entry and exit points in all vertical and horizontal cable chases so as to provide working space to install and maintain cable infrastructure.

G. Do not install communication cables in conduits until all bushings/couplers are installed on the ends of the conduits.

3.7 CABLE SUPPORT HANGERS

A. Cable Saddles and J-hooks: Cable Saddles or “J”-Hook cable support systems for horizontal cabling shall be installed. Refer to drawings for requirements.

B. All horizontal cabling shall extending from the all rooms to the corridors shall be in continuous conduit complete with bushings and connecting hardware from the I/O to within 18 inches of the cable runway system (Div 26 00 00).

C. Provide threaded rod and/or #8AWG wire for supporting hangers when hanging conduits/trays, etc. from floor deck or deck members. Refer to manufacturers' recommendation for proper installation, sizing, and loading of hangers.

D. Minimum 1/2" diameter threaded rod or equivalent and "Uni-strut" or equivalent channel shall be used for hanging cable runway from floor deck or deck members. Follow manufacturer recommendations and standards. Refer to communications drawings for details.

E. Cables shall be neatly bundled using hook and eye (Velcro) type cable straps along common paths. Maximum number of cables per bundle shall not exceed twenty-four 4 pair UTP.

F. Layout cable runs in advance to determine quantities of cable to be installed along pathways, and to insure non-interference from other trade installations.

G. Maximum-stacked height of cable installed in cable runway shall not exceed 2-1/2". Increase width of runway or provide additional runs of cable runway where required to fulfill requirements.

H. Do not support cables from or lay on ceiling suspension system. Do not use electrical, plumbing, or other pipes for support. Cable supports shall be permanently anchored to building structure or substrates. Provide attachment hardware and anchors designed for the structure to which attached, and that are suitably sized to carry the weight of the cables to be supported. Confirm with Architect and/or Prime Contractor on installation procedures for Cable Support System prior to implementation. No Exceptions.

I. Secure and support exposed horizontal cable at intervals not exceeding 4ft and not more than 18 inches from boxes, fittings, outlets.

3.8 BACKBONE CABLING REQUIREMENTS

A. Limit cable-bending radius to 20 times the cable diameter during installation, and 15 times the cable diameter after installation.

B. Pull cables in smooth and regular motions using methods that prevent cable kinking.

C. If necessary use an approved communications cable pulling lubricant.

D. To reduce the occurrence of micro bending of individual fiber strands, use mesh-type, swivel-eye fiber optic pulling grips. This type of pulling grip is recommended for all cable pulling complete with breakaway swivel at 600lbs of pulling tension.

E. Conduit fill shall not exceed 40%.

3.9 CABLE CLEANER AND CABLE PULLING LUBRICANTS

A. Cable cleaners and/or lubricants shall be materials designed and manufactured for telecommunication cabling use.

3.10 HORIZONTAL CABLING REQUIREMENTS

A. Provide all necessary installation materials, hardware, tools and equipment to perform insulation displacement type terminations at all lighting control outlets and patch panel termination materials. Furnish quantities required to terminate all UTP horizontal cables plus percentage.

B. Cabling Method: Provide cabling in j-hooks or conduit, cable support system. Use UL or ETL listed plenum rated cable in all spaces. Conceal raceway and cabling except in unfinished spaces.

C. Utilize conduits/cable runway as indicated on the drawings. All data and voice cables will be routed in a neat and orderly fashion.

D. Examine pathway elements intended for cable. Check raceways and other elements for compliance with space allocations, installation tolerances, debris, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Horizontal cabling when exiting runway and/or conduit shall thereafter be supported with approved materials and space supporting hardware to maintain performance characteristics.

F. Install cable using techniques, practices, and methods that are consistent with specified data cabling and the installed components and that insure specified performance levels of completed and linked signal paths, end to end.

G. Cable Pulling shall not exceed 25lbs of pulling tension typical.

H. Install Cables in continuous lengths from network lighting control communications outlet to specified patch panels for data.

I. Pull cables in smooth and regular motions using methods that prevent cable kinking.

J. Do not bind cables tightly together with tie or other wraps. Wraps shall slip loosely around cables. Use Velcro wraps instead of cables ties for all cable bundling in the MC and TR's.

K. Pull cables without exceeding cable manufacturer's recommended pulling tensions

L. Pull cables simultaneously if more than one is being installed in the same raceway/pathway.

M. Use pulling compound or lubricant if necessary. Use compounds approved for lubricating telecommunications cabling that will not damage conductor or insulation.

N. Use pulling means; including fish tape, cable, rope, and basket weave wire/cable grips that will not damage media or raceway.

O. Install open cabling parallel and perpendicular to surfaces or structural members following surface contours where possible. Cables shall be run above other ducts, pipes, and other installations. Provide surface mount raceway to protect all exposed cabling from damage, confirm with owner for color and manufacture style. No exception for exposed cabling runs.

P. Use no flat or under carpet communications cabling (UTC) without prior written permission of owner or communications consultant.

Q. Separation of Wires: Comply with EIA/TIA-568-A rules for separating unshielded copper communication and data-processing equipment cables from potential EMI sources, including electrical power lines and equipment.

R. Maintain a minimum spacing of 18" from electrical feeders and/or branch circuit wiring.

S. Maintain a minimum spacing of 12" from auxiliary systems cabling.

T. Maintain a 1” separation where UTP cables must pass perpendicularly to electrical, plumbing, or other wiring, conduit, or piping systems. Use non-conduit bushings, if necessary to maintain separation, which allow for the addition of a reasonable number of cables in the future.

U. Maintain communications pathways away from electrical apparatus such as motor driven equipment and transformers, minimum separation distance of 10’-0” is recommended.

V. Terminate horizontal cables in consistent consecutive order. Arrangement of cables on patch panels and two port quick connect termination hardware shall be in ascending order of room numbers. That is, start the wire termination on patch panels and blocks with the cables that are the lowest room number, and place them in the first patch panel and port number. In any building for example, a room 100 would be terminated first; room 101 would be terminated second, etc.

W. Provide 6” service loop for horizontal cables at I/O’s. Locate service loop neatly with in outlet box. (Typical)

X. Maintain twists in cable pairs to within ½” of termination.

Y. Limit cable-bending radius to 20 times the cable diameter during installation, and 15 times the cable diameter after installation.

Z. Use cable acceptable for installation as “Open cabling” in spaces used for environmental air handling (plenum) when installed in accordance with NEC Article 300-22.

AA. All Data wiring shall be terminated in TIA/EIA wiring configuration T-568-B unless Owner/Consultant indicates another termination scheme.

BB. All horizontal cables shall have an installed length less than 90 meters (295ft.).

CC. Communications Outlet Assemblies:

1. Provide quantity to support locations specified on drawings.

2. Verify color with General Contractor/Owner prior to purchase.

3. Acceptable Manufactures: refer to approved manufacturer list.

4. Two port quick connect: Leviton, Panduit, Ortronics.

5. Network lighting Control: Blue Category 5e T-568-B wire scheme 8-pin 8 pos modular jack.

6. Network Lighting Control : Furnish and install qty.(1) two port quick connect at each room near the lighting control power pack..

DD. The cable manufacturer shall test, and provide with each 1000ft. spool/box of horizontal cabling, a factory certified test report guaranteeing each spool/box complies with the electrical performance of the specified Category cable.

EE. Modular System Furniture: Contractor shall supply voice and data termination in Modular System Furniture and/or Custom Built Furniture complete with mounting bracket. Refer to architectural drawings for locations and details if applicable.

3.11 HORIZONTAL COPPER DATA TERMINATION

A. Provide Horizontal UTP, Category 5e, 4-pair, #24 AWG, 400MHz, Plenum Rated Cable: Use one manufacturer only to maintain cable/components. Warranty-shall meet or exceed latest EIA/TIA specifications.

B. Horizontal Cable: The cable jacket shall be printed with a minimum of the following information: Category specified performance marking, Manufacturer, Manufacturer's part number, cable type, listing file number, number of pairs, listing type (i.e., CMP), and sequential footage markings.

1. Cable shall be UL or ETL listed type CMP, TIA/EIA Category 5e with green outer jacket for the lighting control outlet termination.

2. Conductors shall be UTP of a gauge that complies with the Category 5e standard, and have 4 Pairs of solid copper conductors.

3. All Internal conductors insulation composition shall be of Dupont® Teflon FEP Fluoropolymer resin.

4. Color-coding shall match TIA/EIA 568-B standards.

5. Cable shall be listed in the UL or ETL Verified LAN Cable Products Directory. Cable shall meet all tests for current Category 5e specifications.

3.12 LIGHTING CONTROL PATCH CORDS

A. Copper: Provide Category 5e data patch cords in lengths and quantities as specified by Owner/consultant. Verify prior to purchase. Category 5e patch cords will be of the same manufacturer as the Category 5e horizontal data cable.

3.13 ADMINISTRATION, TESTING, AND IDENTIFICATIONS

A. These specifications will be strictly enforced. The contractor must verify that the requirements of the specifications are fully met through testing, active data throughput, and documentation as specified below. This includes confirmation of requirements by demonstration, testing and inspection. Demonstration shall be provided in final walk-through and in soft and printed test data. If part or all pairs of cable do not meet specifications contained in this document, the cable shall be replaced at contractor's cost.

B. Test Plan: provide a complete and detailed test plan for the cabling system specified herein including a complete list of test equipment for UTP and light guide components and accessories. Include procedures for certification, validation, and testing. Furnish factory reel tests for all cable. Owner will require that the Telecommunications Cabling System installed by the contractor be fully certified to meet all necessary requirements to be compliant with referenced IEEE and EIA/TIA specifications.

C. Testing Agency: Contractor will engage a qualified testing agency to perform field quality control testing. This 'agency' may be Contractor's personnel if the manufacturer of the testing equipment certifies them to conduct the required tests.

D. Correct malfunctioning units at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

E. Contractor will complete all work and documentation according to manufacturer guidelines to

insure manufacturer's warranty remains in effect. Contractor shall obtain certificates from manufacturer attesting to warranty being in effect and include certificates with other deliverables due at the completion of the project.

F. Owner reserves the right to be present during any or all of testing.

G. Standards Compliance & Test Requirements: Cabling must meet the indicated performance specifications: TIA/EIA 568-A and TIA/EIA TSB-67 Category 3, TIA 568-A Category 6 or latest.

3.14 LIGHTING CONTROL TESTING (COPPER)

A. Testers shall be calibrated by factory at factory recommended intervals. Produce documentation to validate compliance.

B. Testers shall be a minimum of a class 2 (level IIe), bi-directional, and Category 5e tester.

C. Testers shall be capable of reporting data at all measured points and uploading the data to a printer PC/Printer.

D. Serial number of tester shall be included with the test results.

E. Test cords shall be new factory manufactured leads.

F. No test leads shall be used for greater than 1,000 tests, or the maximum number of tests recommended by manufacturer. Follow manufacturer's recommendations. Produce documentation on manufacturer's testing procedures and recommendation. Provide documentation on conformance with manufacturer testing procedures.

G. Use test leads/patch cord factory made that are "tuned" to test the particular manufacturer's cabling system used for permanent link tests.

H. Certify that tester's software has been updated within the last 30 days prior to testing

I. Testers shall be capable of testing at a minimum to the following levels at 100 MHz and comparable measures at 250, 350, 400 and 500 MHz:

J. Use only approved UTP/Fiber test equipment: Microtest Omni Scanner, Fluke DSP 400, or Agilent/HP Wirescope 350.

K. Tester Parameters: Comply with the following table:

L. Testing on all horizontal/riser and inter-building copper cabling shall be of the Permanent Link type. However, Contractor shall warrant performance based on Channel performance and if required provide patch cords that meet channel performance criteria.

M. The permanent link consists of up to 90m (295ft) of horizontal cabling and one connection at each end and may also include an optional/consolidation point connection (CP).

N. All cabling not tested strictly in accordance with these procedures shall be re-tested at no additional cost to the Owner.

O. 100% of the installed cabling must be tested. All tests must pass acceptance criteria defined in applicable EIA/TIA 568-C.2 Category 5e standard.

P. Test equipment shall be fully charged prior to each days testing.

3.15 PATCH CORD TESTING

A. Provided patch cords shall be new, tested to manufacturer specifications listed and come with full manufacturer factory warranty.

3.16 LABELING

A. System: use a unique, a syllable alphanumeric designation for each cable, and label cable, jacks, connectors, and terminals to which it connects with the same designation. The following is an example of such a labeling system:

1. First syllable identifies and locates wiring lighting control zone or room and floor where cable originates.

B. Label each horizontal cable at four points:

1. General: Label each cable within 4 inches of each termination where it is accessible and readable in a cabinet, junction/splice case, or outlet box, and elsewhere as indicated.

2. Ceiling mounted copper patch panels, two port quick connects, and other terminating equipment: Label each unit and field within that unit within 4 inches from the block or patch panel termination.

3. Cable Schedule: Post in prominent location in each wiring closet and equipment room. List incoming and outgoing cables and their designations, origins, and destinations.

C. Communications room Grounding will be marked conspicuously with permanent plastic labels at each end and location stating “Caution: telecommunication Ground- DO NOT REMOVE”. Indicate the room number of the opposite end of the wire.

D. All copies (printed and electronic) of floor plans shall show outlet locations identified by their unique identifier. Place one copy of all floor plans with I/O’s in each MC/TR room. Coordinate with owner if they require specific requirements, like: lamination and mounting height, etc.

3.17 DOCUMENTATION

A. Test reports must be submitted in hardcopy and electronic format. Hand-written test reports are not acceptable.

a. Hardcopy reports are to be submitted in labeled 3 ring binders with an attached affidavit verifying passing execution of all tests. For large installations, electronic reports with hardcopy summaries are preferred. Hardcopy summary reports shall contain the following information on each row of the report: circuit ID, test specification used, length of cable, date of test, and pass/fail result.

b. Electronic reports are to be submitted on CD-ROM format. If proprietary software is used, disk or CD shall contain any necessary software required to view test results. If the results are delivered in a standard format like Excel, Access, CSV files, etc. then software to read these files are not provided. Electronic reports must be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate must reference traceable circuit numbers that match the electronic record.

B. Test reports shall include the following information for each cabling element tested:

a. Wiremap results that indicate the cabling has no shorts, opens, miss-wires, split, reversed, or crossed pairs, and end-to-end connectivity is achieved.

b. For Category 5e cabling: Attenuation, NEXT, PSNEXT, ACR, Power Sum ACR, Return Loss, ELFEXT, PSELFEXT, Propagation Delay, and Delay Skew data that indicate the worst case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1 MHz to 500 MHz or highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards. Any individual test that fails the relevant performance specification shall be marked as a FAIL.

c. Length (in meters), propagation delay, and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.

d. Cable manufacturer, cable model number/type, and NVP

e. Tester manufacturer, model, serial number, hardware version, and software version.

f. Circuit ID number and project name.

g. Auto test specification used

h. Overall pass/fail indication

i. Date and time of test.

B. Test reports shall be submitted before substantial completion of the project.

3.18 TEST EQUIPMENT

A. Test equipment used under this contract shall be from manufacturers that have a minimum of 5 years experience in producing field test equipment. Manufacturers must be ISO 9001

certified.

B. All test tools of a given type shall be from the same manufacturer, and have compatible electronic results output.

C. The manufacturer of the test equipment must approve test adapter cables. Adapters from other sources are not acceptable.

D. Baseline accuracy of the test equipment must exceed TIA Level IIe (class2), as indicated by independent laboratory testing.

E. Test equipment must be capable of certifying Category 5e, and 6 links/channels.

F. Test equipment must have a dynamic range of at least 100 dB to minimize measurement uncertainty.

G. Test equipment must be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.

H. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.

I. Test equipment must be capable of running individual NEXT, return loss, etc measurements in addition to auto tests. Individual tests increase productivity when diagnosing faults.

J. Test equipment must include a library of cable types, sorted by major manufacturer.

K. Test equipment must store at least 1000 Category 5e auto tests in internal memory.

L. Test equipment must be able to internally group auto tests and cables in project folders for good records management.

M. Test equipment must include DSP technology for support of advanced measurements.

N. Test equipment must make swept frequency measurements in compliance with TIA standards.

O. The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurement.

3.19 SUBSTANTIAL COMPLETION

A. Date for substantial completion: Coordinate with Construction schedule and client's representative at least 3 months in advance for expected communications infrastructure completion date.

3.20 SUPPORT AND WARRANTY

A. Minimum 15-year manufacturer's certified warranty for this specific project shall be submitted in writing with system documentation. Perform installation of cabling system and hardware to insure covering application assurance (workmanship). Contractor shall provide an installation that meets or exceeds the manufacturer requirements and standards for a complete cabling infrastructure.

B. Should the cabling system fail to perform its expected operation within this warranty period due to inferior or faulty material and/or workmanship, the contractor shall promptly make all required corrections without cost to the owner.

END OF SECTION 283113

SECTION 31 05 13

SOILS FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Subsoil materials.
   2. Topsoil materials.

B. Related Sections:
   1. Section 310513 - Aggregates for Earthwork.
   2. Section 320516 - Aggregates for Exterior Improvements.
   3. Section 312213 - Rough Grading.
   4. Section 312323 - Backfill.
   5. Section 312317 - Trenching.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:
   1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:
   1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
   2. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
   3. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

PART 2 PRODUCTS

2.1 SOURCE QUALITY CONTROL

A. Section 014000 - Quality Requirements: Testing and Inspection Services Testing and analysis of soil material.

B. Testing and Analysis of Subsoil Material:Perform in accordance with ASTM D698.

C. Testing and Analysis of Topsoil Material: Perform in accordance with ASTM D698.

D. When tests indicate materials do not meet specified requirements, change material and retest.

E. Furnish materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.1 EXCAVATION

A. Excavate subsoil and topsoil from areas designated. Strip topsoil to full depth of topsoil in designated areas.

B. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials.

C. Remove excess excavated materials subsoil and topsoil not intended for reuse, from site.

D. Remove excavated materials not meeting requirements for subsoil materials and topsoil materials from site.

3.2 STOCKPILING

A. Stockpile materials on site at locations designated by Architect/Engineer.

B. Stockpile in sufficient quantities to meet Project schedule and requirements.

C. Separate differing materials with dividers or stockpile apart to prevent mixing.

D. Prevent intermixing of soil types or contamination.

E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

3.3 STOCKPILE CLEANUP

A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Removing surface debris.
2. Removing designated trees, shrubs, and other plant life.
3. Removing abandoned utilities.
4. Excavating topsoil.

B. Related Sections:
1. Section 312213 - Rough Grading.
2. Section 312318 - Rock Removal.

PART 2 EXECUTION

2.1 EXAMINATION

A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify existing plant life designated to remain is tagged or identified.

C. Identify waste area for placing removed materials.

2.2 PREPARATION

A. Call Local Utility Line Information not less than three working days before performing Work.
1. Request underground utilities to be located and marked within and surrounding construction areas.

2.3 PROTECTION

A. Locate, identify, and protect utilities indicated to remain, from damage.

B. Protect trees, plant growth, and features designated to remain, as final landscaping

C. Protect bench marks, survey control points, and existing structures from damage or displacement.

2.4 CLEARING

A. Clear areas required for access to site and execution of Work.

B. Remove trees and shrubs within marked areas. Remove stumps.

C. Clear undergrowth and deadwood, without disturbing subsoil.

D. Apply herbicide to remaining stumps to inhibit growth.

2.5 REMOVAL

A. Remove debris, rock, and extracted plant life from site.

B. Remove abandoned utilities. Indicated removal termination point for underground utilities on Record Documents.

C. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.

D. Do not burn or bury materials on site. Leave site in clean condition.

2.6 TOPSOIL EXCAVATION

A. Excavate topsoil from areas to be further excavated, relandscaped, or regraded, without mixing with foreign materials for use in finish grading.

B. Do not excavate wet topsoil.

C. Stockpile in area designated on site to depth not exceeding 8 feet and protect from erosion.

D. Remove excess topsoil not intended for reuse, from site.

END OF SECTION

SECTION 31 22 13

ROUGH GRADING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Excavating topsoil.
2. Excavating subsoil.
3. Cutting, grading, filling, compacting site for site structures, building pads.

B. Related Sections:
1. Section 310513 - Soils for Earthwork: Soils for fill.
2. Section 310516 - Aggregates for Earthwork: Aggregates for fill.
3. Section 311000 - Site Clearing: Excavating topsoil.
4. Section 312316 - Excavation and Fill: Building excavation.
5. Section 312318 - Rock Removal.
6. Section 312323 - Backfill: General building area backfilling.
7. Section 312317 - Trenching: Trenching and backfilling for utilities.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:
1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
3. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
6. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
7. ASTM D2434 - Standard Test Method for Permeability of Granular Soils (Constant Head).
8. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
9. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

PART 2 EXECUTION

2.1 PREPARATION

A. Call Local Utility Line Information service not less than three working days before performing Work.
   1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Identify required lines, levels, contours, and datum.

C. Protect utilities indicated to remain from damage.

D. Protect bench marks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

2.2 FILLING

A. Fill areas to contours and elevations with unfrozen materials.

B. Place fill material in continuous layers and compact as required.

C. Maintain optimum moisture content of fill materials to attain required compaction density.

D. Slope grade away from building minimum 2 percent slope for minimum distance of 10 ft, unless noted otherwise.

E. Make grade changes gradual. Blend slope into level areas.

2.3 FIELD QUALITY CONTROL

A. Perform in place compaction tests in accordance with the following:
   1. As required by geotechnical engineer.

END OF SECTION

SECTION 31 23 16

EXCAVATION AND FILL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Soil densification.
2. Excavating for building foundations.
3. Excavating for slabs-on-grade.
4. Excavating for site structures.

B. Related Sections:
1. Section 310513 - Soils for Earthwork: Stockpiling excavated materials.
2. Section 310516 - Aggregates for Earthwork: Stockpiling excavated materials.
3. Section 312213 - Rough Grading: Topsoil and subsoil removal from site surface.
4. Section 312318- Rock Removal: Removal of rock during excavating.
5. Section 312323- Backfill.
6. Section 312317 - Trenching: Excavating for utility trenches.

1.2 REFERENCES

A. ASTM International:
1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
3. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
4. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

B. Local utility standards when working within 24 inches of utility lines.

PART 2 EXECUTION

2.1 EXCAVATION

A. Underpin adjacent structures which may be damaged by excavation work.

B. Excavate subsoil to accommodate building foundations, slabs-on-grade.

C. Excavate to working elevation for piling work.

D. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with Section 02320 and Section 02324.

E. Grade top perimeter of excavation to prevent surface water from draining into excavation.

F. Trim excavation. Remove loose matter.

G. Notify Architect/Engineer of unexpected subsurface conditions.

H. Correct areas over excavated with structural fill.

I. Remove excess and unsuitable material from site.

J. Repair or replace items indicated to remain damaged by excavation.

2.2 PROTECTION

A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

END OF SECTION

SECTION 31 31 16

TERMITE CONTROL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Soil treatment for termite control.

B. Related Sections:
   1. Section 310513 - Soils for Earthwork: Backfill materials.
   2. Section 312316 - Excavation and Fill: Subgrade preparation.
   3. Section 033000 - Cast-In-Place Concrete: Slabs on grade and foundations placed over treated soil.

1.2 REFERENCES

A. Environmental Protection Agency:
   1. EPA FIFRA - Federal Insecticide, Fungicide and Rodenticide Act.

B. National Pest Management Association:
   1. NPMA WDO - Wood Destroying Organism Library.

1.3 SUBMITTALS

A. Product Data: Submit toxicants to be used, composition by percentage, dilution schedule, intended application rate. Include product label information.

B. Test Reports: Indicate regulatory agency approval reports.

C. Manufacturer's Application Instructions: Indicate caution requirements and in accordance with current product label of chosen pesticide.

D. Certify applications followed NPMA WDO for termite control or other regional location guidance.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record moisture content of soil before application, date and rate of application, areas of application, diary of toxicity meter readings and corresponding soil coverage.

B. Operation and Maintenance Data: Indicate re-treatment schedule.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Applicator: Company specializing in performing the Work of this sectionand licensed in State of Texas.

1.6 SEQUENCING

A. Section 011000 - Summary: Work sequence.

B. Apply toxicant immediately prior to installation of vapor barrier under slabs-on-grade in accordance with product label supplemented by the NPCA’s ARP for termiticiding or local requirements.

1.7 WARRANTY

A. Warranty: Include coverage for damage and repairs to building and building contents caused by termites. Repair damage. Re-treat where required.

PART 2 PRODUCTS

2.1 MATERIALS

A. Toxicant Chemical: EPA FIFRA approved; synthetically color dyed to permit visual identification of treated soil.

B. Diluent: Recommended by toxicant manufacturer.

2.2 MIXES

A. Mix toxicant to manufacturer's instructions.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 013000 - Administrative Requirements:Verification of existing conditions before starting work.

B. Verify soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.

C. Verify final grading and excavation are complete.

3.2 APPLICATION

A. Apply toxicant at locations indicated in Schedule at end of section.

B. Apply extra treatment to structure penetration surfaces including pipe or ducts, and soil penetrations including grounding rods or posts.

C. Re-treat disturbed treated soil with same toxicant as original treatment.

D. When inspection or testing identifies presence of termites, re-treat soil and re-test.

3.3 PROTECTION OF FINISHED WORK

A. Section 017000 - Execution Requirements: Protecting finished Work.

B. Do not permit soil grading over treated work.

END OF SECTION