IDEA PUBLIC SCHOOLS
BROWNSVILLE ROBINDALE ACADEMY AND COLLEGE PREP
PHASE I

BROWNSVILLE, TEXAS

ARCHITECTS - PLANNERS
Gomez Mendez Saenz, Inc.

CONSULTANTS
Mejia & Rose, Inc.
Green Rubiano & Associates
Ethos Engineering
SSP Design



5/11/18

Set No.

REQUEST FOR COMPETITIVE SEALED PROPOSALS

IDEA PUBLIC SCHOOLS BROWNSVILLE ROBINDALE AND SOUTH MCALLEN

IDEA Public Schools will accept Competitive Sealed Proposals for the construction of the following projects:

1. IDEA BROWNSVILLE ROBINDALE PHASE I. Proposals are due no later than 4:00 p.m. on Thursday, May 31, 2018
2. IDEA SOUTH McALLEN PHASE I. Proposals are due no later than 4:00 p.m. on Tuesday, June 5, 2018

Proposals are due at the IDEA Headquarters, 2115 W. Pike Blvd. Weslaco, TX 78596. No proposal shall be accepted after the above listed deadlines. Proposals will be read aloud immediately after bid due date and time.

Each Project consists of a new 2-story building addition of approximately 79,600 sq ft, and associated parking. Projects also include site grading, utilities, and landscaping. Estimated budget for each project is $11.5 million.

Plans and Specifications will be available beginning May 14, 2018, from Gomez Mendez Saenz, Inc., 1150 Paredes Line Rd., Brownsville, TX 78521 (956) 546-0110 which will be issued in Electronic File Format. All prospective proposers must obtain the Electronic File information directly from Gomez Mendez Saenz, Inc. in order to be placed on the official bidders list. No hardcopies will be distributed.

Gomez Mendez Saenz is the Architect of Record. You can contact David Monreal by email at dmonreal@gmsarchitects.com or (956) 546-0110 with questions about plans.

A joint Pre-Proposal Conference will be held to discuss both projects. Details included in the Bid Documents. All Proposers are encouraged to attend.

IDEA reserves the right to reject any and/or all bids, to waive technicalities, to re-advertise or to proceed in the best interest of the school.

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INSTRUCTIONS FOR COMPETITIVE SEALED PROPOSALS
IDEA PUBLIC SCHOOLS BROWNSVILLE ROBINDALE PHASE I

GENERAL

GOMEZ MENDEZ SAENZ, INC. has prepared Construction Documents for the IDEA PUBLIC SCHOOLS BROWNSVILLE ROBINDALE PHASE I which is to be located in Brownsville, Texas.

The Board has delegated to Mr. Wyatt Truscheit, CFO, authority to select the construction procurement methodology, to determine evaluation/ranking criteria, to rank respondents, and to select the respondent that will provide best value to IDEA Public School and to then negotiate a contract with the selected respondent. The IDEA CFO has selected the Competitive Sealed Proposal method for this Project. Idea Public Schools is requesting proposals from firms to provide construction services as General Contractor for the construction of Idea Brownsville Robindale Phase I and related site improvements on a property in Brownsville, Texas by IDEA Public Schools.

SCOPE

Each Project consists of a new 2-story building addition of approximately 79,600 sq ft, and associated parking. Projects also include site grading, utilities, and landscaping.

The work is to be done under one General Construction Contract which will include General, Mechanical, Electrical and Ancillary Construction work complete as required by the Contract Documents.

CONSTRUCTION PROPOSAL DOCUMENTS

Copies of Construction Proposal Documents may be examined at the Architect's Office, 1150 Paredes Line Rd., Brownsville, Texas 78521.

COMPLETE SETS OF CONSTRUCTION PROPOSAL DOCUMENTS (DRAWINGS & SPECIFICATIONS) may be obtained from the Architect in electronic form by written request to David Monreal at dmonreal@gmsarchitects.com or by calling (956) 546-0110. No hard copies will be provided. Offerors may print the bid documents at their own expense for the purposes of the bid only.

No partial sets of Construction Proposal Documents will be issued. Neither the Owner nor Architect assumes responsibility for error or misinterpretations resulting from the use of incomplete construction Proposal Documents for proposal or construction purposes.

The Proposer shall carefully study and compare the Construction Proposal Documents with each other and shall at once report to the Architect errors, inconsistencies or ambiguities discovered.

Proposers or Sub-Proposers may make a written request for clarification or interpretation of the Construction Proposal Documents which must reach the Architect at least seven days prior to the date for receipt of Competitive Sealed Proposals.

Clarifications, interpretations and changes of the Construction Proposal Documents will be made only by written Addendum issued by the Architect to each person to whom the Architect has issued Construction Proposal Documents. Proposers shall not rely on clarifications, interpretations and changes made in any other manner.

Requirements of any Addendum issued before Competitive Sealed Proposals are to be received are to be covered in the proposal and, in executing the Contract; the Addenda so issued shall become a part of the Contract Documents.

Established Plan Rooms to which the Architect will issue construction proposal documents include:

AGC OF AMERICA
Rio Grande Valley Chapter
Main Office and Plan Room
6918 W. Expressway 83 (P. O. Box 391-78551)
Harlingen, TX 78520
Phone: (956) 423-4091
Fax: (956) 423-0174

DODGE DATA (ON LINE SERVICE) – www.construction.com

CONSTRUCT CONNECT - www.constructconnect.com

VIRTUAL BUILDERS EXCHANGE - www.virtualbx.com

SUBSTITUTIONS
The materials, products and equipment described in the Construction Proposal Documents establish a standard of required function, dimension, appearance and quality. Substitutions will be considered or approved prior to receipt of Proposals.

PRE-PROPOSAL CONFERENCE
There will be Pre-proposal Conference at, Idea Public Schools, 2115 W. Pike Blvd., Weslaco, Texas 78596; Tuesday, May 22, 2018 at 10:00 a.m. Interested firms are strongly encouraged to attend.

SUBMISSION OF PROPOSAL
The board has delegated the authority to open bids proposals to the Architect/Engineer of Record or its independent Project Manager.

Sealed, written Proposals, addressed to Owner, will be received at:

IDEA PUBLIC SCHOOLS - ADMINISTRATION OFFICE
2115 W. PIKE BLVD.
WESLACO, TEXAS 78596

Until 4:00 p.m., Thursday, May 31, 2018. Any Proposal received after the hour named will be subject to rejection.

Bid submissions that are accepted will be read aloud immediately after receipt by the Architect.

Proposals must be submitted in triplicate on the uniform Proposal form provided by Architects. Amounts, where indicated, must be stated in figures as well as words.

In case of a difference in written words and figures in a Proposal, the amount stated in written words shall govern.

Mailed proposals shall be addressed to the Owner at the above address and shall be clearly marked "HOLD FOR BID OPENING – IDEA PUBLIC SCHOOLS BROWNSVILLE ROBINDALE PHASE I". Submit Proposal in an opaque, sealed envelope identified with project name and name of Proposer.

The Proposal must include the legal name of the Proposer and must be signed by a person or persons legally authorized to bind the Proposer to a contract. A Proposal by a corporation shall further include the state of incorporation and have the corporate seal affixed.

No Proposal may be modified after same has been submitted. A Proposal may be withdrawn, however, and resubmitted any time prior to the time set for receipt of the Proposals. Oral, telephonic or telegraphic Proposals and/or modifications will not receive consideration.

Owner reserves the right to reject any and/or all Proposals, to disregard any informality in any proposal and accept the Proposal which, in the Owner's judgment, is in the Owner's own best interest.

Proposals shall be subject to Owner's acceptance for a period of sixty (60) calendar days from date of receipt of Proposals.

BID SECURITY

The Proposers must deposit with the Proposal a Cashier's, Certified Check or Proposal Bond executed by a satisfactory Surety Company, in the amount of FIVE (5%) PERCENT of the largest possible total proposal amount, made payable to Owner. The Proposer to whom the award is made will be promptly notified. If a Proposer (a) withdraws his proposal within thirty (30) calendar days after the date of time fixed for the opening of proposals in the Request for Competitive Sealed Proposals, or (b) fails or refuses to execute the Agreement, or other required forms within five (5) days after the same are presented to him for signature, or (c) fails or refuses to furnish properly executed Performance and Payment Bonds and Certification of Required Insurance within five (5) days of execution date of the Agreement, the Owner may award the work to another Proposer of Proposers or may call for new proposals.

Proposal Bond is forfeited if proposal is withdrawn after the proposal opening, or Contract

Documents are not executed in accordance with the above.

CONTRACTOR'S QUALIFICATION

Proposers shall submit evidence in the form of a Contractor's Qualification Statement of compliance with the following requirements:

1) Proposers shall have completed two projects of similar scope and complexity within the past two years.

2) Proposers shall have an established office in Texas with at least five years of experience.

3) Proposers are to submit financial statements for the last three (3) years along with an "Accountants Review Report" from accountant.

Proposers shall submit with their Base Proposal in the same envelope a Contractor's Qualification statement, fully executed and indicating compliance with the above qualifications, on an original American Institute of Architects Document A305, 1986 Edition. Photo copies of facsimiles of original forms will not be acceptable.

The Owner will evaluate and consider, in the qualifications and acceptance of the Proposers, all information relevant to his interests and requirements, as provided on the Contractor's Qualifications Statement and any information on past work from references provided therein. The Owner reserves the right to qualify or disqualify any Proposal based on any information provided for Contractor's Qualification, in any names permitted by applicable law.

BONDS REQUIRED

Contractor will be required to provide Performance Bond and Payment Bond, each in the amount of 100% of the Contract Amount, issued by sureties duly authorized and submitted to do business in the State of Texas and licensed by the State of Texas.

CRIMINAL HISTORY

Contractors will be required to comply with Senate Bill 9 Security Requirements on this project.

WAGES

Salaries or wages of all labor, including services of superintendent, assistant superintendent, field engineers, job supervisors, clerks, security personnel, truck drivers, mechanics, laborers, and all other necessary for the proper conduct of the Work and for the time employed on the Work, shall not be more than the usual wage scale paid such workers in the vicinity of the Project for the type of Work set forth under this agreement.

SITE EXAMINATION

Proposer will be held responsible to have examined the premises and become familiar with the existing conditions under which the Contractor will be obliged to operate and to have correlated the Proposer's personal observations with the requirements of the Contract Documents.

In case Proposer finds any discrepancy between conditions at the site and requirements of these Drawings and Specifications, the Bidder shall so notify the Architect and Architect will issue any required revisions to the Bid Documents by written Addendum as described hereinbefore.

LOCATION AND ACCESS TO PREMISES

A. The project is located on the SE Corner of Robindale Rd. & FM 802, Brownsville, TX 78526.

B. The offeror shall have free access to the premises for the purpose of acquainting himself with the conditions, delivering equipment, and performing the work necessary to fulfill the contract.

TIME OF COMPLETION

General Contractor must be completed by June 1, 2019. Time extensions shall be submitted for review on a monthly basis.

Liability - Owner and Contractor recognize that time is of the essence in this Agreement and that Owner will suffer financial loss if the Work is not completed within the time specified in Paragraph 3.1 above, plus any extension thereof allowed in accordance with Article 8 of the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal proceeding, the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring such proof, Owner and Contractor agree that as liquidated damages for delay (but not as penalty) Contractor shall pay Owner One Thousand and 00/100 Dollars ($1,000.00) for each day that expires after the time specified in Paragraph 3.1 for Substantial Completion until the work is substantially complete.

SUB-CONTRACTORS & SUPPLIERS

Proposer shall include with his proposal a list of Sub-Contractors and Material Suppliers (per list furnished by Architect) which are proposed to be used on the project. The list shall be plainly identified as to the content, project name and Proposer's name.

FORM OF CONTRACT

The Agreement for the Work will be written on Standard Form of Agreement Between Owner and Contractor (AIA Document A101, 2007 Edition), and as may be amended.

CONSIDERATION OF PROPOSAL

A. Properly identified Proposals received on time will be considered.

B. The Owner shall have the right to reject any or all Proposal and in particular to reject a Proposal not accompanied by any required security bond or data required by the Contract Documents or a Proposal in any way incomplete or irregular.

C. The Owner shall have the right to waive any formality or irregularity in any proposal received.

D. If the Owner accepts any Alternates, the Owner shall have the right to accept them in any

order or combination.

E. It is the intent of the Owner to award a contract to the offeror submitting the proposal providing the "best value" to the district provided the Proposal has been submitted in accordance with the requirements of the Contract Documents, selection criteria and adopted by the Owner.

F. Award of Contract may include full consideration of Unit Prices and Alternates if any. Owner may accept or reject any or all alternates if any.

G. The selection of Building Contractors will be based on the enclosed Ranking Criteria.

H. Contractor may provide supplemental information to support selection criteria. The support information will not be disclosed to other Offerors.

I. The estimated budget is as follows: $11.5 Million

STATE SALES TAX

A. This project is exempt from most sales tax. A sales tax exemption certificate may be obtained by request from PMSI, the Owner's representative.

END OF SECTION

Ranking Evaluation and Ranking Criteria

The Board has delegated the authority to establish the ranking criteria and method of contracting to the Chief Financial Officer. The Chief Financial Officer has elected to use the Competitive Sealed Proposal contract method with the following selection criteria.

The district reserves the right to apply all criteria as deemed appropriate and allowed in the Texas Education Code 44.031 (b). Including but not limited to, as provided by section 44.031 (b), Part (8), other relevant factors specifically denoted in the bid package. The district specifically requests offerors to answer or provide the information to the following selection criteria. Questions left unanswered or omitted requested information may result in a partial or total reduction of allocated points.

Criteria	**Weight**
Proposal Amount	40 Points
Firm Experience/Key Personnel and Firm Stability/Management Similar Successful Projects Including Quality Construction, Timely Completion Prompt Project Closeout	30 Points
Proposed Subcontractor Team	10 Points
Prior Experience with IDEA, PMSI, Architect and/or Consultant Scaled Between Excellent - full credit Poor Experience or No Experience – No Credit	20 Points
	100 Points

Proposal Amount (40 Points):

The district will consider the total contract cost on the base bid price as part of the evaluation process. Alternates will be included in the Competitive Bid price evaluation only if the base price plus the alternate price(s) are within the project budget. If the base price plus the alternate(s) exceed the budget, only the base price will be used in the price evaluation process. After the highest ranked firm is selected, negotiations on price and changes on the scope of work may include alternate(s).

Points will be awarded based on Offerors' deviation from the lowest price received. The following formula will be used to determine point value for each offeror: Lowest Bid / Offeror's Bid X Max Point Value = Points Awarded. See **example** below for point determination. This example assumes that four (4) bids were received with a low bid of $2,500,000 and a high bid of $3,000,000. The Offerors would receive points per the following chart.

Contractor Ranking Form for Price

Assuming Price is 40 Points

Contractor No.	Price	Formula	Points Awarded
1	$2,500,000	$2,500,000 / $2,500,000 X 40 =	40
2	$2,550,000	$2,500,000 / $2,550,000 X 40 =	39
3	$2,800,000	$2,500,000 / $2,800,000 X 40 =	36
4	$3,000,000	$2,500,000 / $3,000,000 X 40 =	33

Firm Experience/Key Personnel and Firm Stability/Management (30 Points):

In order to get points relating to construction experience and performance, the offeror must submit the following information:

Include an organizational chart for your proposed management team. Include, at a minimum, the name of the principal-in-charge for the firm as well as the following staff: Project Manager (Primary decision maker), superintendent(s), project engineer, and safety manager. The safety manager may have other roles, such as project superintendent or project manager, but must be on-site full time. Staffing strength is or significant importance to IDEA Public Schools and changes to proposed staff (or staff options) without the prior approval of IDEA Public Schools may be grounds for termination prior to construction phase services.

List a minimum of five (5) projects for which you have provided, or are providing, services that are most related to this project. Identify similar challenges and describe your approach. List the projects in order of priority, with the most relevant project listed first. Provide the following information for each project listed:

- Project name, location, contract delivery method, and description
- Color images (photographic or machine reproductions)
- Initial budget and final Construction Cost, including Change Orders
- Type of construction (new, renovation, or expansion)
- Description of services respondent provided for the project during preconstruction
- The Owner's name and representative, including telephone number and email address
- Length of business relationship with the Owner
- The Architect's contact information, including telephone number and email address

References shall be considered relevant based on specific project participation and experience with the Respondent. The Owner may contact references during any part of this process. Regarding these projects, identify which staff members were on the featured projects.

Describe how your firm's quality control team will measure the quality of construction and

commissioning performed by mechanical and electrical subcontractors and how will you address non-conforming work.

Describe your firms warranty service support philosophy and your approach to warranty service implementation.

List any liens that Offeror has had on any projects.

List any project-related lawsuits that Offeror has had, or is currently involved in.

Proposed Subcontractor Team (May be submitted 48 hours after bid opening) (10 Points)

List of Sub-Contractors may be submitted at the time of Bid or within 48 hours after Bid. If not sure on certain trades, please provide list of potential subcontractors. Do not leave blank. Email list dmonreal@gmsarchitects.com If lists are not received within 48 hours after bid, no points will be received for this section. Substitution of unacceptable subcontractors during negotiation with the highest ranked contractor may be grounds for disqualification of the contractor and movement to the next highest ranked offeror.

Experience with IDEA Public Schools, PMSI, Architect and/or Consultants (20 Points)

The full credit of 10 points will be given to Offerors whose prior project experience with IDEA and/or IDEA's project team has been excellent. If experience is "standard", 5 points will be given. If IDEA and/or IDEA's project team had a poor experience with an Offeror, no points will be awarded.

Other Required Information to be submitted (No Point Value)

The Offer must submit the following items. No point values are assigned to these items but will be used in overall evaluation of Offeror.

1. Review and acknowledge the contract included in the Front End of the Specifications issued for this project and list any objections or modifications to the contract. (No Point Value - Basis of rejection dependent on gravity of revisions)

2. Provide certified financial statements for the past 3 years (IDEA reserves the right to disqualify firms that cannot show financial stability in a satisfactory manner to the Owner. Financial information provided will not be shared with anyone outside of IDEA and the selection team.

3. IDEA is interested in understanding the stability of your firm in terms of managed growth. Provide information showing measured corporate work trends in the form of total projects relative to firm resources or a work load analysis based on gross billings for the prior (3) years and projecting through 2018 assuming that your firm is awarded this Project. The intent is to understand your firm's growth and trajectory and the company's ability to successfully manage projects based on historical and future trends. Explain any anomalies or major deviations on the charts provided. (No Point Value - Basis of rejection dependent on company stability)

4. Provide the number of Surety companies that your company has engaged over the last (2) years, the name(s) of the Surety company, and the number of years that your firm has consistently engaged the Surety company(ies). (No Point Value - Basis of rejection dependent on Surety information)

Notification of Criminal History of Contractor

In accordance with Section 44.034, of the Texas Education Code, a person of business entity that enters into a contract with a school district must give advance notice to the district if the person or any owner or operator of the business entity has been convicted of a felony. The notice must include a general description of the conduct resulting in the conviction of a felony.

This section does not apply to a publicly held corporation (Section 44.034.(c). If your firm is incorporated, please submit an attested written document stating that the offering firm is a publicly held corporation, legitimately conducting business in the State of Texas.

Ranking Criteria for
Selection of Building Contractors

Project Name: _____ Contractor: _____

Project Location(s): _____ Bid/Proposal: _____

Ranking Date: _____ Bid Opening Date: _____

CATEGORY	Maximum Score		Total Points Scored
1. PRICE (40 pts.)			
• Construction Cost	40		_____
2. FIRM EXPERIENCE / KEY PERSONNEL AND FIRM STABILITY (30 pts)			
• Team Organization Chart (proposed management team) Projects of Comparable Size Firms Quality Control Firms Warranty Service Philosophy	30		_____
		Subtotal	_____
3. Proposed Subcontractor Team (10 pts)			
• Subcontractor Team	10		_____
		Subtotal	_____
4. Prior Experience with IDEA Public Schools (20 pts)			
• Past Experience with IDEA Public Schools PMSI, Architect and/or Consultants	20	_____	_____
		Subtotal	_____
TOTAL POINTS SCORED	100pts.	**Grand total**	_____

AIA® Document A701™ – 1997

Instructions to Bidders

for the following PROJECT:
(Name and location or address)
Idea Public Schools Brownsville Robindale
Brownsville, Texas

THE OWNER:
(Name, legal status and address)
Idea Public Schools
2115 W. Pike Blvd.
Weslaco, Texas 78596

THE ARCHITECT:
(Name, legal status and address)
Gomez Mendez Saenz, Inc.
1150 Paredes Line Rd.
Brownsville, Texas 78521

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

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ARTICLE 1 DEFINITIONS

§ 1.1 Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement or Invitation to Bid, Instructions to Bidders, Supplementary Instructions to Bidders, the bid form, and other sample bidding and contract forms. The proposed Contract Documents consist of the form of Agreement between the Owner and Contractor, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications and all Addenda issued prior to execution of the Contract.

§ 1.2 Definitions set forth in the General Conditions of the Contract for Construction, AIA Document A201, or in other Contract Documents are applicable to the Bidding Documents.

§ 1.3 Addenda are written or graphic instruments issued by the Architect prior to the execution of the Contract which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.

§ 1.4 A Bid is a complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

§ 1.5 The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids.

§ 1.6 An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.

§ 1.7 A Unit Price is an amount stated in the Bid as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.

§ 1.8 A Bidder is a person or entity who submits a Bid and who meets the requirements set forth in the Bidding Documents.

§ 1.9 A Sub-bidder is a person or entity who submits a bid to a Bidder for materials, equipment or labor for a portion of the Work.

ARTICLE 2 BIDDER'S REPRESENTATIONS

§ 2.1 The Bidder by making a Bid represents that:

§ 2.1.1 The Bidder has read and understands the Bidding Documents or Contract Documents, to the extent that such documentation relates to the Work for which the Bid is submitted, and for other portions of the Project, if any, being bid concurrently or presently under construction.

§ 2.1.2 The Bid is made in compliance with the Bidding Documents.

§ 2.1.3 The Bidder has visited the site, become familiar with local conditions under which the Work is to be performed and has correlated the Bidder's personal observations with the requirements of the proposed Contract Documents.

§ 2.1.4 The Bid is based upon the materials, equipment and systems required by the Bidding Documents without exception.

ARTICLE 3 BIDDING DOCUMENTS

§ 3.1 COPIES

§ 3.1.1 Bidders may obtain complete sets of the Bidding Documents from the issuing office designated in the Advertisement or Invitation to Bid in the number and for the deposit sum, if any, stated therein. The deposit will be refunded to Bidders who submit a bona fide Bid and return the Bidding Documents in good condition within ten days after receipt of Bids. The cost of replacement of missing or damaged documents will be deducted from the deposit. A Bidder receiving a Contract award may retain the Bidding Documents and the Bidder's deposit will be refunded.

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§ 3.1.2 Bidding Documents will not be issued directly to Sub-bidders unless specifically offered in the Advertisement or Invitation to Bid, or in supplementary instructions to bidders.

§ 3.1.3 Bidders shall use complete sets of Bidding Documents in preparing Bids; neither the Owner nor Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

§ 3.1.4 The Owner and Architect may make copies of the Bidding Documents available on the above terms for the purpose of obtaining Bids on the Work. No license or grant of use is conferred by issuance of copies of the Bidding Documents.

§ 3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

§ 3.2.1 The Bidder shall carefully study and compare the Bidding Documents with each other, and with other work being bid concurrently or presently under construction to the extent that it relates to the Work for which the Bid is submitted, shall examine the site and local conditions, and shall at once report to the Architect errors, inconsistencies or ambiguities discovered.

§ 3.2.2 Bidders and Sub-bidders requiring clarification or interpretation of the Bidding Documents shall make a written request which shall reach the Architect at least seven days prior to the date for receipt of Bids.

§ 3.2.3 Interpretations, corrections and changes of the Bidding Documents will be made by Addendum. Interpretations, corrections and changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon them.

§ 3.3 SUBSTITUTIONS

§ 3.3.1 The materials, products and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution.

§ 3.3.2 No substitution will be considered prior to receipt of Bids unless written request for approval has been received by the Architect at least ten days prior to the date for receipt of Bids. Such requests shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution including drawings, performance and test data, and other information necessary for an evaluation. A statement setting forth changes in other materials, equipment or other portions of the Work, including changes in the work of other contracts that incorporation of the proposed substitution would require, shall be included. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

§ 3.3.3 If the Architect approves a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approvals made in any other manner.

§ 3.3.4 No substitutions will be considered after the Contract award unless specifically provided for in the Contract Documents.

§ 3.4 ADDENDA

§ 3.4.1 Addenda will be transmitted to all who are known by the issuing office to have received a complete set of Bidding Documents.

§ 3.4.2 Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

§ 3.4.3 Addenda will be issued no later than four days prior to the date for receipt of Bids except an Addendum withdrawing the request for Bids or one which includes postponement of the date for receipt of Bids.

§ 3.4.4 Each Bidder shall ascertain prior to submitting a Bid that the Bidder has received all Addenda issued, and the Bidder shall acknowledge their receipt in the Bid.

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ARTICLE 4 BIDDING PROCEDURES

§ 4.1 PREPARATION OF BIDS

§ 4.1.1 Bids shall be submitted on the forms included with the Bidding Documents.

§ 4.1.2 All blanks on the bid form shall be legibly executed in a non-erasable medium.

§ 4.1.3 Sums shall be expressed in both words and figures. In case of discrepancy, the amount written in words shall govern.

§ 4.1.4 Interlineations, alterations and erasures must be initialed by the signer of the Bid.

§ 4.1.5 All requested Alternates shall be bid. If no change in the Base Bid is required, enter "No Change."

§ 4.1.6 Where two or more Bids for designated portions of the Work have been requested, the Bidder may, without forfeiture of the bid security, state the Bidder's refusal to accept award of less than the combination of Bids stipulated by the Bidder. The Bidder shall make no additional stipulations on the bid form nor qualify the Bid in any other manner.

§ 4.1.7 Each copy of the Bid shall state the legal name of the Bidder and the nature of legal form of the Bidder. The Bidder shall provide evidence of legal authority to perform within the jurisdiction of the Work. Each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further give the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current power of attorney attached certifying the agent's authority to bind the Bidder.

§ 4.2 BID SECURITY

§ 4.2.1 Each Bid shall be accompanied by a bid security in the form and amount required if so stipulated in the Instructions to Bidders. The Bidder pledges to enter into a Contract with the Owner on the terms stated in the Bid and will, if required, furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds if required, the amount of the bid security shall be forfeited to the Owner as liquidated damages, not as a penalty. The amount of the bid security shall not be forfeited to the Owner in the event the Owner fails to comply with Section 6.2.

§ 4.2.2 If a surety bond is required, it shall be written on AIA Document A310, Bid Bond, unless otherwise provided in the Bidding Documents, and the attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of the power of attorney.

§ 4.2.3 The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until either (a) the Contract has been executed and bonds, if required, have been furnished, or (b) the specified time has elapsed so that Bids may be withdrawn or (c) all Bids have been rejected.

§ 4.3 SUBMISSION OF BIDS

§ 4.3.1 All copies of the Bid, the bid security, if any, and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party receiving the Bids and shall be identified with the Project name, the Bidder's name and address and, if applicable, the designated portion of the Work for which the Bid is submitted. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

§ 4.3.2 Bids shall be deposited at the designated location prior to the time and date for receipt of Bids. Bids received after the time and date for receipt of Bids will be returned unopened.

§ 4.3.3 The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.

§ 4.3.4 Oral, telephonic, telegraphic, facsimile or other electronically transmitted bids will not be considered.

§ 4.4 MODIFICATION OR WITHDRAWAL OF BID

§ 4.4.1 A Bid may not be modified, withdrawn or canceled by the Bidder during the stipulated time period following the time and date designated for the receipt of Bids, and each Bidder so agrees in submitting a Bid.

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§ 4.4.2 Prior to the time and date designated for receipt of Bids, a Bid submitted may be modified or withdrawn by notice to the party receiving Bids at the place designated for receipt of Bids. Such notice shall be in writing over the signature of the Bidder. Written confirmation over the signature of the Bidder shall be received, and date- and time-stamped by the receiving party on or before the date and time set for receipt of Bids. A change shall be so worded as not to reveal the amount of the original Bid.

§ 4.4.3 Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids provided that they are then fully in conformance with these Instructions to Bidders.

§ 4.4.4 Bid security, if required, shall be in an amount sufficient for the Bid as resubmitted.

ARTICLE 5 CONSIDERATION OF BIDS

§ 5.1 OPENING OF BIDS

At the discretion of the Owner, if stipulated in the Advertisement or Invitation to Bid, the properly identified Bids received on time will be publicly opened and will be read aloud. An abstract of the Bids may be made available to Bidders.

§ 5.2 REJECTION OF BIDS

The Owner shall have the right to reject any or all Bids. A Bid not accompanied by a required bid security or by other data required by the Bidding Documents, or a Bid which is in any way incomplete or irregular is subject to rejection.

§ 5.3 ACCEPTANCE OF BID (AWARD)

§ 5.3.1 It is the intent of the Owner to award a Contract to the lowest qualified Bidder provided the Bid has been submitted in accordance with the requirements of the Bidding Documents and does not exceed the funds available. The Owner shall have the right to waive informalities and irregularities in a Bid received and to accept the Bid which, in the Owner's judgment, is in the Owner's own best interests.

§ 5.3.2 The Owner shall have the right to accept Alternates in any order or combination, unless otherwise specifically provided in the Bidding Documents, and to determine the low Bidder on the basis of the sum of the Base Bid and Alternates accepted.

ARTICLE 6 POST-BID INFORMATION

§ 6.1 CONTRACTOR'S QUALIFICATION STATEMENT

Bidders to whom award of a Contract is under consideration shall submit to the Architect, upon request, a properly executed AIA Document A305, Contractor's Qualification Statement, unless such a Statement has been previously required and submitted as a prerequisite to the issuance of Bidding Documents.

§ 6.2 OWNER'S FINANCIAL CAPABILITY

The Owner shall, at the request of the Bidder to whom award of a Contract is under consideration and no later than seven days prior to the expiration of the time for withdrawal of Bids, furnish to the Bidder reasonable evidence that financial arrangements have been made to fulfill the Owner's obligations under the Contract. Unless such reasonable evidence is furnished, the Bidder will not be required to execute the Agreement between the Owner and Contractor.

§ 6.3 SUBMITTALS

§ 6.3.1 The Bidder shall, as soon as practicable or as stipulated in the Bidding Documents, after notification of selection for the award of a Contract, furnish to the Owner through the Architect in writing:

.1 a designation of the Work to be performed with the Bidder's own forces;

.2 names of the manufacturers, products, and the suppliers of principal items or systems of materials and equipment proposed for the Work; and

.3 names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for the principal portions of the Work.

§ 6.3.2 The Bidder will be required to establish to the satisfaction of the Architect and Owner the reliability and responsibility of the persons or entities proposed to furnish and perform the Work described in the Bidding Documents.

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§ 6.3.3 Prior to the execution of the Contract, the Architect will notify the Bidder in writing if either the Owner or Architect, after due investigation, has reasonable objection to a person or entity proposed by the Bidder. If the Owner or Architect has reasonable objection to a proposed person or entity, the Bidder may, at the Bidder's option, (1) withdraw the Bid or (2) submit an acceptable substitute person or entity with an adjustment in the Base Bid or Alternate Bid to cover the difference in cost occasioned by such substitution. The Owner may accept the adjusted bid price or disqualify the Bidder. In the event of either withdrawal or disqualification, bid security will not be forfeited.

§ 6.3.4 Persons and entities proposed by the Bidder and to whom the Owner and Architect have made no reasonable objection must be used on the Work for which they were proposed and shall not be changed except with the written consent of the Owner and Architect.

ARTICLE 7 PERFORMANCE BOND AND PAYMENT BOND

§ 7.1 BOND REQUIREMENTS

§ 7.1.1 If stipulated in the Bidding Documents, the Bidder shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Bonds may be secured through the Bidder's usual sources.

§ 7.1.2 If the furnishing of such bonds is stipulated in the Bidding Documents, the cost shall be included in the Bid. If the furnishing of such bonds is required after receipt of bids and before execution of the Contract, the cost of such bonds shall be added to the Bid in determining the Contract Sum.

§ 7.1.3 If the Owner requires that bonds be secured from other than the Bidder's usual sources, changes in cost will be adjusted as provided in the Contract Documents.

§ 7.2 TIME OF DELIVERY AND FORM OF BONDS

§ 7.2.1 The Bidder shall deliver the required bonds to the Owner not later than three days following the date of execution of the Contract. If the Work is to be commenced prior thereto in response to a letter of intent, the Bidder shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished and delivered in accordance with this Section 7.2.1.

§ 7.2.2 Unless otherwise provided, the bonds shall be written on AIA Document A312, Performance Bond and Payment Bond. Both bonds shall be written in the amount of the Contract Sum.

§ 7.2.3 The bonds shall be dated on or after the date of the Contract.

§ 7.2.4 The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the power of attorney.

ARTICLE 8 FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

Unless otherwise required in the Bidding Documents, the Agreement for the Work will be written on AIA Document A101, Standard Form of Agreement Between Owner and Contractor Where the Basis of Payment Is a Stipulated Sum.

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SUPPLEMENT TO INSTRUCTION TO BIDDERS (A701)

ADD TO ART. 3.1.1 ELECTRONIC FILES OF BID DOCUMENTS (DRAWINGS & SPECIFICATIONS) may be obtained from the Architects by PRIME BIDDERS, bonafide Bidders and Suppliers or Sub-Contract Bidders upon receipt of a completed Authorization and Waiver for Release of Electronic Files Form provided by the Architect.

ADD ART. 3.2.1.1 EXAMINATION OF SITE
Bidder will be held responsible to have examined the premises and become familiar with the existing conditions under which the Contractor will be obliged to operate and that will in any manner affect the work under this Contract. Should an error in the Drawings or specifications become known to the Bidder, he shall so notify the Architect, in writing before opening of bids and Architect will issue any required revisions to the Bid Documents by written Addendum as described herein before.

ADD ART. 3.2.4.1 In the event of a conflict between the plans and specifications, which is not resolved by addenda, the bidder is to bid the most expensive item.

ADD ART. 3.2.5 No interpretation of the meaning of the plans, specifications or other pre-bid documents will be made to any bidder orally.

ADD ART. 3.4.5 Failure of any bidder to receive any such addendum or interpretation shall not relieve such bidder from any obligation under his bid as submitted or compliance with all items covered in the addendum. All addenda so issued shall become part of the contract documents.

ADD TO ART. 4.1.1 Submit Bid (in triplicate) on the uniform Bid forms prepared by Architects. Amounts, where indicated, must be stated in figures as well as words; and Bids must be signed by Bidder, with the full name if an individual; and the Corporate name with the name of the Executive Officer, attested by the Secretary, if a Corporation; and with the firm name and by at least one of the partners if a Partnership.

ADD ART. 4.1.8 Submit name of Job Superintendent that will undertake the project and his/her qualifications.

ADD TO ART. 4.2.1 All proposals shall be accompanied by cashier or certified check or bidder's bond in the amount of five percent (5%) payable to the Owner without recourse to the Owner. Bids without check or bid bond inadequate amounts will not be considered.

ADD ART. 4.3.5 In case of a difference in written words and figures in a Bid, the amount stated in written words shall govern.

ADD ART. 6.1.2 Qualification of Bidder: The Owner may make such investigations as he deems necessary to determine the ability of the bidder to perform the work, and the bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the Owner that such bidder is properly qualified to carry out the obligations of the contract and to complete the work contemplated therein.

ADD ART. 6.1.3 The successful bidder shall submit with his performance and payment bonds a list of all subcontractors and the name of the Job Superintendent and his qualifications.

ADD TO ART. 6.2 Subcontracts: The bidder is specifically advised that any person, firm or other party to whom it is proposed to award a subcontract under this contract must be acceptable to the Owner and to the Architect.

ADD TO ART. 7.1.1. SECURITY - Acceptable security of 5% and construction security of 100% is required as per Instructions to Bidders. To be acceptable to the Owner, Bidders Bonds shall be from a surety listed in the latest Department of Treasury, Dept. Circular 570; 2017 Revision; listing COMPANIES HOLDING CERTIFICATES OF AUTHORITY AS ACCEPTABLE SURETIES ON FEDERAL BONDS AND AS ACCEPTABLE REINSURING COMPANIES, effective July 1, 2017. A copy of this Federal Register is on hand in the Architect's Office and may be inspected upon request.

"In the event the listed bonding company is not listed in the latest Dept. Circular 570; 2017 Revision as an acceptable surety, the following should be supplied:

The Company shall supply a certificate from the State Board of Insurance which states the amount of the allowed capital and surplus as of the date of the last annual statutory financial statement for the surety company for the bond for each bidder.

In the event the amount of the bond is in excess of 10% of the surety company's capital and surplus, the surety company is to provide written certification from the State Board of Insurance that the surety company has reinsured the portion of the risk that exceeds 10% of the surety company's capital and surplus with one or more reinsurers who are duly authorized, accredited, or trustee to do business in the state. The certification shall further provide that the reinsurers in question are indeed authorized, accredited, and trustee to do business in this state."

ADD TO ART. 8.1.1The successful bidder must furnish performance and payment bonds upon the forms which are attached hereto in the amount of 100% of the contract price from an approved surety company holding a permit from the State of Texas to act as surety (and acceptable according to the latest list of companies holding certificates of authority from the Secretary of Treasury of the United States) or other surety or sureties acceptable to the Owner.

ADD TO ART. 9.1 NOTICE OF SPECIAL CONDITIONS: Attention is particularly called to those parts of the contract documents and specifications which deal with the following:

A. Inspection and testing of materials
B. Insurance requirements
C. Stated Allowances
D. Coordination of work by others
E. Coordination of work site with others.

BID PROPOSAL FORM
(GENERAL CONTRACT)

Project: Idea Public Schools Brownsville Robindale Phase I
Place: Idea Public Schools, 2115 W. Pike Blvd., Weslaco, Texas 78596
Date: Thursday, May 31, 2018
Time: 4:00 p.m.

1. Pursuant to and in compliance with the Invitation to Bid and the proposed Contract Documents, prepared by Gomez Mendez Saenz, Inc. relating to the above referenced project, the undersigned, having become thoroughly familiar with the terms and conditions of the proposed Contract Documents and with local conditions affecting the performance and costs of the work at the place where the work is to be completed, and having fully inspected the site in all particulars, hereby proposes and agrees to fully perform the work within the time stated and in strict accordance with the proposed Contract Documents, and addenda, thereto, including furnishing of any and all labor and materials for all General Construction and Site Work, for the following sum of money:

A: BID:
All labor, materials, services and equipment, necessary for completion of the work shown on the drawings and described in the specifications for the **IDEA BROWNSVILLE ROBINDALE PHASE I**._____

_____

_____DOLLARS ($)

B. ALTERNATES:
All labor, materials, services and equipment, necessary for completion of the work shown on the drawings and in the specifications.

Alternate No. 1: Provide Domestic Water Booster Pumps as indicated on Plumbing Drawings._____

_____

_____DOLLARS ($)

C. KITCHEN EQUIPMENT COST:
The below lump sum cost should include delivery, installation and contractor mark-up. DO NOT include plumbing, electrical or mechanical rough-in to equipment. Provide price for ALL Kitchen Equipment as listed in Specification Section **11400 Food Service Equipment**; include kitchen walk-ins as listed in Specification Section **11410 Walk-In Cooler/Freezer**; include the kitchen hood as listed in Specification **233813 Commercial Kitchen Hoods**. A detailed itemized list of individual equipment may be requested post-bid by request only. The below sum should already be included in BASE BID. _____

_____

_____DOLLARS ($)

2. If awarded this Contract the undersigned will execute a satisfactory Construction Contract, Performance Bond, Labor and Material Payment Bond and proof of insurance coverage, with the Owner for the entire work as per the Contract Documents within 10 days after notice of award. It is agreed that this proposal is subjected to the Owner's acceptance for a period of Thirty (30) calendar days from the above date.

3. This building must be completed by **June 1, 2019**. Time extensions shall be submitted for review on a monthly basis.

4. Enclosed is a Certified Check or Bidders Bond in the amount of $_____ in compliance with the specification requirements. (5% of the highest amount bid).

The above check or Bidders Bond is to become the property of the Owner in the event the Construction Contract (when offered by the Owner) and the bonds and proof of insurance coverage are not executed within the time set forth above.

5. The undersigned agrees to the following:

- To furnish all materials as shown and specified in the plans and specifications.
- To start work 5 days after notice of award of contract.
- To work _____ working days per week.

6. The full amount of all allowances as specified in the General Requirements, Division 1, of the specifications, in the Base Proposal price shown.

7. Receipt is acknowledged of the following addendas:

No.	Dated	No.	Dated	No.	Dated
No.	Dated	No.	Dated	No.	Dated

8. Bidder agrees that the Owner has the right to accept or reject any or all bids and to waive all informalities.

9. A list of Sub-Contractors and Material Suppliers which are proposed to be used on this project is included with this proposal in a separate envelope. Upon acceptance of proposal, substitution of Sub-Contractors or Suppliers listed may be made only with approval by the Owner.

10. By signing, bidder acknowledges that **ALL ALLOWANCES** have been included in the Base Bid.

Respectfully submitted,

_____
CONTRACTOR

(SEAL: - if Bid is by a Corporation)

By: _____

Title: _____

Address: _____
Street or Box City State Zip

Telephone (____) _____

Fax: (____) _____

FILL IN APPLICABLE INFORMATION:

A CORPORATION, Chartered in the STATE of _____, authorized to do business in the State of TEXAS

A PARTNERSHIP composed of: _____

AN INDIVIDUAL, operating under the name of: _____

Instructions to School District Contractors
Regarding Criminal History Background Searches
Under Senate Bill 9

Senate Bill 9 directs school district contractors (i.e., Company) to obtain state and national criminal history background searches on their employees who will have direct contact with students, and to receive those results through the DPS criminal history clearinghouse (Fingerprint-based Applicant Clearinghouse of Texas – FACT). In order for contractors to receive the information through FACT, they must first establish an account with the DPS for FACT clearinghouse access. The Company owner must sign a user agreement with the DPS. To obtain the user agreement and more information, Company must contact:

Access and Dissemination Bureau
Texas Department of Public Safety
Crime Records Service
P. O. Box 149322
Austin, Texas 78714-9322

Email: FACT@t xdps. st at e.t x. us
Phone: (512) 424-2365

For fastest service, please email or call. State in the message that Company is a school district contractor and needs to have an account established for DPS FACT clearinghouse access. Please include:

Company Name
Company Address
Company Phone
Name of Company point of contact
Phone of Company point of contact
Company email to be used for notification of FACT records and messages

The information in the DPS FACT Clearinghouse is confidential, and access must be restricted to the least number of persons needed to review the records. The account must include at least one designated supervisor to make necessary changes and to monitor the site's security and the access to the criminal history data retrieved. Additional users must be limited to those who need to request, retrieve, or evaluate data regarding the individual applicants.

PLEASE NOTE: After the Company signs the DPS User Agreement for FACT, DPS will provide the Company with a revised ***FAST Fingerprint Pass*** that Company will have to provide to its employees and applicants. Company's employees and applicants will use that ***FAST Fingerprint Pass*** when scheduling their FAST fingerprinting.

Contractor Criminal Background Certification

Introduction: Texas Education Code Chapter 22 requires service contractors to obtain criminal history record information regarding covered employees and to certify that fact to the District. Covered employees with disqualifying convictions are prohibited from serving at a school district.

Definitions:

Covered employees: All employees of a contractor who have or will have continuing duties related to the service to be performed at the District and have or will have direct contact with students. The District will be the final arbiter of what constitutes direct contact with students.

Disqualifying conviction: One of the following offenses, if at the time of the offense, the victim was under 18 or enrolled in a public school: (a) a felony offense under Title 5, Texas Penal Code; (b) an offense for which a defendant is required to register as a sex offender under Chapter 62, Texas Code of Criminal Procedure; or (c) an equivalent offense under federal law or the laws of another state; or (d) the conviction of a felony or misdemeanor that would disqualify a person from obtaining certification as an educator under Texas Education Code 21.060.

Note: For covered persons hired on or after January 1, 2008, fingerprinting and photographing of the covered person is required. A covered person is considered to have been employed by a service contractor as of the date the covered person first provided services for compensation.

On behalf of _____ ("Contractor"), I certify that [check one]:

[ ] None of Contractor's employees are *covered employees*, as defined above.

Or

[ ] Some or all of Contractor's employees are *covered employees*. If this box is selected, I further certify that:

(1) Contractor has obtained all required criminal history record information, through the Texas Department of Public Safety, regarding its covered employees. None of the covered employees has a disqualifying conviction. Contractor has taken reasonable steps to ensure that its employees who are not covered employees do not have continuing duties related to the contract services or direct contact with students.

(2) If Contractor receives information that a covered employee has a disqualifying conviction, Contractor will immediately remove the covered employee from contract duties and notify the District in writing within three (3) business days.

(3) Upon request, Contractor will make available for the District's inspection the criminal history record information of any covered employee. If the District objects to the assignment of a covered employee on the basis of the covered employee's criminal history record information, Contractor agrees to discontinue using that covered employee to provide services at the District.

Noncompliance by Contractor with this certification may be grounds for contract termination.

Company Name:_____/Submitter's Name/Title:_____

Email Address: (PLEASE TYPE EMAIL ADDRESS)_____

Submitter's Signature:_____Telephone No._____/ 800 # (if available)

Fax No._____ Date:_____

Address:_____City, State and Zip Code:_____

This form is required to be completed and signed however, only the successful Proposers will be required to comply with requirement set forth in Act of May 28, 2007, 80th Leg., R.S., S.B. 9, § 30. All related costs including background checks/fingerprinting shall be at the contractor's expense.

Revised February 1, 2011

This sheet must be completed, signed, and returned with Prime Contractor's submittal

Subcontractor Form

Undersigned shall employ, subject to the Owner's approval, the following subcontractor for the Request for Proposal. **One (1) form must be provided for each and every subcontractor employed.** The prime Proposer shall bear the sole responsibility for the successful completion of work performed by the below listed third party service provider(s).

Service provided by Subcontractor:	
Name of Subcontractor:	
Address:	
City/State/Zip:	
Telephone:	
Fax Number:	
E-Mail Address:	
Point of Contact:	
Business Days/Hours:	
No. Years in Business Under This Name:	
No. Years at Location Listed:	
No. Personnel Employed:	

Subcontractor Name:_____/Submitter's Name/Title:_____

Address:_____City, State and Zip Code:_____

Email Address: _____

Submitter's Signature:_____Telephone No._____

Fax No._____800 # (if available)_____

Date:_____

Note: Due to provisions made to Contracted Services Criminal History by HB 2730, effective September 1, 2009, all subcontractors must certify to the District, that the subcontractor complied and adheres to the Criminal History check requirements.

All subcontractors identified above, must complete the "Subcontractor Criminal Background Certification" form.

This sheet must be completed, signed, and returned with Prime Contractor's submittal

Revised February 1, 2011

Subcontractor Criminal Background Certification

Introduction: Texas Education Code Chapter 22 requires service subcontractors to obtain criminal history record information regarding covered employees and to certify that fact to the District. Covered employees with disqualifying convictions are prohibited from serving at a school district.

Definitions:

Covered employees: All employees of a subcontractor who have or will have continuing duties related to the service to be performed at the District and have or will have direct contact with students. The District will be the final arbiter of what constitutes direct contact with students.

Disqualifying conviction: One of the following offenses, if at the time of the offense, the victim was under 18 or enrolled in a public school: (a) a felony offense under Title 5, Texas Penal Code; (b) an offense for which a defendant is required to register as a sex offender under Chapter 62, Texas Code of Criminal Procedure; (c) an equivalent offense under federal law or the laws of another state; or (d) the conviction of a felony or misdemeanor that would disqualify a person from obtaining certification as an educator under Texas Education Code 21.060. This same standard applies to employees of subcontractors.

Note: For covered persons hired on or after January 1, 2008, fingerprinting and photographing of the covered person is required. A covered person is considered to have been employed by a service contractor as of the date the covered person first provided services for compensation

On behalf of _____ ("Subcontractor"), I certify that [check one]:

[ ] None of subcontractor's employees are *covered employees*, as defined above.
Or
[ ] Some or all of subcontractor's employees are *covered employees*. If this box is selected, I further certify that:

(1) Subcontractor has obtained all required criminal history record information, through the Texas Department of Public Safety, regarding its covered employees. None of the covered employees has a disqualifying conviction. Subcontractor has taken reasonable steps to ensure that its employees who are not covered employees do not have continuing duties related to the contract services or direct contact with students.
(2) If Subcontractor receives information that a covered employee has a disqualifying conviction, subcontractor will immediately remove the covered employee from contract duties and notify the District in writing within three (3) business days.
(3) Upon request, Subcontractor will make available for the District's inspection the criminal history record information of any covered employee. If the District objects to the assignment of a covered employee on the basis of the covered employee's criminal history record information, Subcontractor agrees to discontinue using that covered employee to provide services at the District.

Noncompliance by Subcontractor with this certification may be grounds for contract termination.

Subcontractor Name:_____/Submitter's Name/Title:_____

Email Address: (PLEASE TYPE EMAIL ADDRESS)_____

Submitter's Signature:_____Telephone No._____/ 800 # (if available)_____

Fax No._____ Date:_____

Address:_____ City, State and Zip Code:

This form is required to be completed and signed however, only the successful Proposers will be required to comply with requirement set forth in Act of May 28, 2007, 80th Leg., R.S., S.B. 9, § 30. All related costs including background checks/fingerprinting shall be at the sub- contractor's expense.

Revised February 1, 2011

This sheet must be completed, signed, and returned with Prime Contractor's submittal

Certification of Criminal History Background Checks for Contractors
Questions and Answers

1. Where do I find the new law?

The new law is found in Texas Education Code § 22.0834, which can be accessed through www.tlo2.tlc.state.tx.us/statutes/statutes.html. This new law was created through the enactment of Senate Bill 9 ("SB 9") by the 80th Legislature. Senate Bill 9 can be accessed through the Texas Legislative website at www.capitol.state.tx.us and typing SB 9 into the search engine. Information regarding the fingerprinting obligations required by Senate Bill 9 can also be found on the Department of Public Safety ("DPS") website at www.txdps.state.tx.us. Much of the information set forth in this Question-and-Answer document can also be found in the DPS publication, *Senate Bill 9 Background Check for Education: A Reference Guide*.

2. My company has been dealing with the school district for years with no problems. Why do I have to do anything different now?

SB 9 has made potential changes for everyone who works with, or around, Texas schoolchildren. The purpose of the new law is to provide better safeguards for children. The employees of a Texas public school district will now have to be fingerprinted. Their information will be placed into a national criminal history database. As an entity that contracts with a Texas public school district, you potentially have individuals who may come into contact with schoolchildren. These individuals are now required to have some type of criminal history background check before they can perform their duties on school property.

3. Surely I do not have to conduct a criminal history background check on my receptionist and other employees who will never come into contact with a student! How do I know if the employee has to undergo a background check at all?

You are correct that many employees will not have to undergo any type of criminal history background check at all. In order to determine whether an employee must undergo a criminal history background check, you must consider whether the person "has or will have continuing duties related to the contracted services" and whether the person "has or will have direct contact with students." These phrases have become terms of art whose definitions are very important to the decision of whether an individual must undergo a criminal background check. Unfortunately, at this time, there are no official definitions for what each phrase actually means. If you have already completed a certification for IDEA Public Schools, then you used the definitions provided on the certification form itself that our legal advisors recommended that we use. At the time of this writing, the Texas Education Agency was considering language for use in regulations that, once adopted, will offer a uniform definition of these phrases for use statewide. Until those regulations are adopted, our legal advisors recommend the following definitions that conform to the definitions on the certification form:

(1) "Continuing duties related to the contracted services" –

Regular, repetitive work duties that will be performed on District property, rather than a one-time or infrequent appearance or engagement.

(2) "Direct contact with students" –

Verbal or physical interaction with one or more students that is necessary for the performance of contracted services or that offers an opportunity for unsupervised interaction with students. Services that offer "direct contact" opportunities are those that are performed independently from school district staff involvement.

Direct contact can include chance contact, such as performing routine inspections or maintenance; contact with groups of students during organized activities; or more obvious examples, such as tutoring or therapy. However, incidental conduct that does not provide the opportunity for unsupervised interaction with a particular student, such as addressing an assembly, officiating at a sports contest, or judging an extracurricular event, is not "direct contact."

4. I keep hearing about the "fingerprinting law." Am I going to have to start fingerprinting my employees in order to comply with this new law?

The answer to this question depends on how long the covered employee has worked for you. There are two different types of criminal history background checks that are referenced in TEC § 22.0834:

(1) Finger print Search Required – Any new employee hired on or after January 1, 2008, that meets the definition of the type of employee who must undergo a criminal history background check (as stated above), will have to submit fingerprints for "national criminal history record information."

(2) Name-Based Check / Finger prints Search Not Required – If you hired the person before January 1, 2008, and they meet the definition of the type of employee who must undergo a criminal history background check, then they will not have to submit fingerprints, but you will have to obtain their criminal history record information from any law enforcement or criminal justice agency or private entity that is a consumer reporting agency governed by the Fair Credit Reporting Act (15 U.S.C. §§ 1681, et seq.).

We explain in Questions #7 and 8 how to conduct the two different types of background checks.

5. What is the difference between a fingerprint-based search and a name-based search?

According to the Department of Public Safety website, a fingerprint-based search is the most accurate method available of returning records based on matching fingerprints; a name-based search has a greater potential to match multiple candidates, as the search relies on a comparison of similar-sounding names or, if requested, names spelled exactly alike. With a name-based search, it is possible to match against records that do not relate to the person in whom you are interested, and it is possible to miss the record that does relate to the person in whom you are interested. For more questions and answers regarding criminal history searches, go to the Department of Public Safety's website at www.txdps.state.tx.us/administration/crimerecords.

6. How do I conduct a name-based search on the employees who worked for me prior to January 1, 2008, who are otherwise covered?

State statute requires this criminal history record information to be obtained from any law enforcement or criminal justice agency or private entity that is a consumer reporting agency governed by the Fair Credit Reporting Act (15 U.S.C. §§ 1681, et seq.). Therefore, the name-based searches do not have to be

conducted through the Department of Public Safety and can be conducted using any private background search provider that is required to operate through the Fair Credit Reporting Act.1

7. How do I conduct a fingerprint search on my employees hired on or after January 1, 2008, or on new hires who are otherwise covered?

Step 1 – Establish an account with DPS Fingerprint-based Applicant Clearinghouse of Texas ("FACT"), which is a new service developed by DPS to ultimately fulfill the criminal history background checks of all non-criminal justice entities and to immediately fulfill the needs required by Senate Bill 9.

FACT Account – Submit a request to establish a FACT account to the Access and Dissemination Bureau of the Texas Department of Public Safety, Crime Records Service, as a PDF file via FACT@txdps.state.tx.us, or to their address at P.O. Box 149322, Austin, Texas 78714-9322. On the email or letter, you should state:

I am a contractor for a Texas public school district, specifically, the following District: IDEA Public Schools, applying for access to the DPS FACT clearinghouse. Please forward the necessary application information to me at the following email address:

_____.

Website Access – The Access and Dissemination Bureau will send you a response via email that will give you the address of a website where you must go to sign up for access to FACT. You will follow the instructions for FACT access. On that website, you will be given information regarding the following requirements:

Necessary Documents – Download, sign and return the following documents: (original signed copies must be sent via regular mail to DPS, Access and Dissemination Bureau, within 14 days. A signed copy can also be faxed to DPS).

(1) Secure Site User Agreement
(2) FACT User Agreement

Signing these documents says that you are agreeing to abide by the Security Policy for Non-Criminal Justice Agency Access, Use, and Dissemination of Criminal History Record Information.

(3) Front and Signature Page from Contract with District

You will be requested to send a front page and signature page from your contract with the school district. Attach to the Bid Proposal a copy to the Access and Dissemination Bureau and send one with the other signed agreements via regular mail.

Message Center – On that website, you will also receive information regarding your Message Center on the website. DPS will notify you when you have been approved, and a Fast Fingerprint Pass Form that has a User Number for your company to use on FACT will be sent to your Message Center.

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1 *Senate Bill 9 Background Checks for Education: A Reference Guide*, January 1, 2008; www.txdps.state.tx.us/administration/crime_records/docs/sb9referenceguide.pdf ; page 9

FAST Finger print Pass F or m – The acronym FAST stands for "Fingerprint Applicant Services of Texas" (not to be confused with FACT). You will give a copy of the FAST form to every covered employee who must be fingerprinted (hired by you on or after January 1, 2008, and having continuing duties related to the contracted services that involve direct contact with students). There is a telephone number and email address on the form. The employee must contact the DPS FAST representative at this number or email address and set up an appointment to be fingerprinted.

Step 2 – The employee must bring the FAST Fingerprint Pass Form to the scheduled appointment. The employee will have to pay a fee either when he/she schedules the appointment or when he/she actually gets fingerprinted.

Fees –

$44.20 - The total charges for the fingerprinting process, including the background checks. This fee includes the $9.95 fingerprint fee, as well as the $15 DPS fingerprint search fee and the $19.95 FBI fingerprint search fee. It is a per-person fee.

Subsequent queries after the initial entry into the FACT system are $1.00.

Payment Methods–

(1) Online, by credit card or debit card, at the time that the fingerprinting is scheduled. (Extra $2 fee is added to the $44.20, making the total $46.20).

(2) Personal check, cashier's check, or money order at the time of fingerprinting.

Finger prints – After the fingerprints are taken, the FAST representative will send them to DPS and they will be searched through the Automated Fingerprint Identification System ("AFIS"), which checks those individuals arrested in Texas. DPS will also send them to the FBI, to be searched in the FBI AFIS system, to see if the person has been arrested in another state. The information will be collected by DPS and placed into the FACT Clearinghouse.

Results – You will receive an email notice that the results are available to review. To review the results, you must sign on to the FACT website.

Future Arrests – When you are first notified of the results of the employee's background check, you are also automatically subscribed to that person's record on the FACT system, and you will receive an email update if the person is arrested in Texas. If you ever receive an email update, you will have to sign on to the FACT website and review the notice.

It is our understanding that once an individual is in the FACT system, subsequent queries can be made using their driver's license number, and cost is $1.00. Therefore, you should only have to go through the fingerprinting process for an employee one time, regardless of the number of different school districts that the employee might serve.

8. Can I go to the local police station to get my fingerprints?

No. In 2005, the Department of Public Safety entered into a contract with an L-1 Identity Solutions Company to provide statewide fingerprinting. The Fingerprint Applicant Services of Texas ("FAST") was created by that contract. A "livescan" fingerprinting device is used to take electronic fingerprints. A digital photograph will also be taken. Although some school districts have purchased their own livescan

equipment, this is not the same type of equipment used when standard fingerprints are taken at a police station.

9. What do I do with the criminal history information when I receive it through the FACT system?

You must review it to determine whether the employee has any convictions that would prohibit employment with you for the contracted services. You must then certify to the school district with which you contract that you have received all required criminal history information. Use the certification form provided by the District.

10. What convictions will mean that an employee is automatically prohibited by state law from serving at the district?

These are found on the certification form and include:

- Title 5 felony offense convictions, which include all Offenses Against the Person. These can be found online at **Error! Hyperlink reference not valid.**and include criminal homicide, kidnapping and unlawful restraint; trafficking of persons; and sexual and assaultive offenses, and the offenses that fall under each of these categories.
- Offense that requires the individual to register as a sex offender; or
- Equivalent offense under the laws of another state;

AND, at the time the offense occurred, the victim was under the age of 18 or was enrolled in a public school.

An employee with any of the above criminal histories is prohibited from serving on a campus in a capacity that will render them a covered person.

11. What if I review the information and cannot determine whether the employee has or has not been convicted of an act that would prohibit services at a public school district?

Because the District is charged by law with the requirement of ensuring that all contracting entities have obtained all criminal history record information and may not allow an employee of a contracting entity who has a prohibited conviction from serving at the district, the District's Human Resources Department will assist you in reviewing the criminal history record information if you are uncertain of whether a conviction qualifies as a prohibited conviction. The District may also independently obtain the criminal history record information of one of your employees, or one of your subcontractor's employees, who will be serving at the District. Nevertheless, you must provide the certification to the District prior to sending your employees to serve.

12. I am a contractor who subcontracts a lot of jobs to complete my projects for the District. These individuals are not really my employees, so do I have to conduct criminal background checks on them before sending them to a school district?

Yes. Subcontractors who otherwise meet the definition of a "covered person" (explained in Question #4) must undergo a criminal background check. The definition of "covered person" in state law is an individual who is not an applicant for or holder of a Chapter 21 certificate and is employed or offered

employment by an entity that contracts with a school district to provide services.2 Although the state regulations have not yet been adopted (or even fully drafted), we have consistently seen "covered person" defined to include the employees of a contractor's subcontractors, as well as independent contractors who perform work for the district. The bottom line is – if you intend to provide a service to the District, anyone who performs work for you on a school campus is potentially considered a "covered person."

13. Okay, so going back to who is covered and who is not covered, my receptionist, who never leaves my main office that is 20 miles from any school, will not have to undergo a criminal background check, but the workers who lay brick for my subcontractor for the new elementary school cafeteria will have to undergo a background check. How can I prevent or at least lessen my burden?

According to our legal advisors, if the covered person does not have "continuing duties related to the contracted services" or does not have "direct contact with students," he or she would fall outside of the definition of covered person and would not have to undergo a criminal background check. Therefore, if the services that you are providing on a school campus do not otherwise require unsupervised interaction with students, ensuring that incidental unsupervised interaction does not occur would mean that a criminal history background check would not have to be conducted on those individuals. Some ideas that might assist you in making job assignments and/or ensuring that the opportunity for "direct contact with students" is not available include:

- Provide a portable toilet that is on a school campus if workers will be present during school hours.
- Fence off any job sites that are located on a school campus.
- Plan construction work on a school campus to be conducted during non-school hours.
- Draft rules for workers, and the subcontractors and their workers, that make clear the prohibitions against any student contact, whether direct or incidental.

This is not a comprehensive list. If you have ideas regarding how you can ensure that "direct contact" with district students will not occur, we encourage you to share your ideas with us. Furthermore, if you determine that individuals are not "covered" because precautions such as those listed above are put into place, you must ensure that the employees do not have direct contact with students.

14. What do I do with the criminal history information?

Complete the certification form included in this packet. There is also a certification form included in many of the District's agreements. The school district's obligation with respect to contracting entities is to receive a certification from each contracting entity that all of the required criminal history background checks have been conducted.3 This certification should be completed prior to the performance of any services under the contract.

15. What if I am an independent contractor?

An independent contractor must comply with the new law. The Commissioner of Education has not yet published rules; however, at this time, it is our understanding that the draft rules may define the date of employment for an independent contractor as the date of the contract or agreement with the District, rather than the date that the employee was employed or offered employment by the contracting entity.

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2 Tex. Educ. Code § 22.0834
3 Tex. Educ. Code § 22.0834(i)

Additionally, the rules may also allow an independent contractor with a regular continuing series of agreements, with no break in performance of more than a calendar year, to consider the earliest date of employment to be the employment date. What this means for the independent contractor who has an ongoing relationship with the District that involves agreements on a semester-by-semester basis or otherwise is that the contractor can go back to the earliest agreement date in determining whether a name-based check can be conducted (employment prior to January 1, 2008) or whether a national criminal history background check, involving fingerprints and photographs, must be conducted.

If you are an independent contractor with a new relationship with the District, you must undergo the national criminal history background check. This involves the information set forth in Question #7. However, it is important to note that it is our understanding that once an individual is in the FACT system, subsequent queries can be made using your driver's license number. Subsequent queries are $1.00.

16. What should I do when an employee ceases to be employed by me?

According to DPS, you should unsubscribe to that person's criminal history through the FACT system. Otherwise, you will continue to receive notices regarding the person's criminal history, even though you are only authorized to see his/her criminal history as long as he/she is employed by you. When you click "unsubscribe" on the FACT system website, the person will stay on your list of employees, but will be inactive. You can reactivate the person's record if he/she returns to employment with you in a capacity that would require the criminal background check. This feature will assist you with seasonal employees who leave and return often. Unauthorized access to criminal history background information is a crime.4

17. What should I do if I receive an update regarding the criminal history of an employee who is serving at the District?

If you receive an email notice that an employee has been arrested in Texas, you must sign in to the FACT system and review the notice. According to DPS, you must verify that the person is still employed with you prior to reviewing the notice. On the certification form, you agreed to notify the District within three (3) days of receiving information that a covered employee is ineligible for service at the District. The District has the right to review these employees' criminal histories; therefore, if you are unsure as to whether the employee has been rendered ineligible, send the District a copy of the notice and remove the employee from service at the District pending a final District decision.

18. I left the FACT system website up on my computer screen and went for a cup of coffee. When I returned, my 19-year-old nephew and his friend, who are working for me over the summer, were reviewing the criminal histories of our employees. What are the legal implications of this action?

We recommend that if a security breach occurs, you contact DPS immediately. You could be found in violation of the law that prohibits unauthorized access to criminal history information. You are only allowed to use the FACT system for purposes involving service to the school district under the laws set forth in Senate Bill 9. The FACT system has a security policy that you must read and follow. Additionally, DPS has stated that they will audit the use of the criminal file history and of the FACT system to verify that the information is only being requested and used for authorized purposes. It is your responsibility to keep the information confidential and limit access to the least number of persons needed to review records. The contact information for DPS regarding questions is:

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4 Tex. Gov't Code § 411.083

FAC T@txdps.state.tx.us; (512) 424-2365

19. Who is my contact at the District?

If you have questions that involve service to the District or must send criminal history regarding an employee to the District for review, you should contact:

Peter Hayes (512)989-7045

His office may direct you to another District department for assistance or to DPS for assistance with legal information and information pertaining to the FACT system.

List of Sub-Contractors may be submitted at the time of Bid or within 48 hours after Bid. If not sure on certain trades, please provide list of potential subcontractors. Do not leave blank. Email list to dmonreal@gmsarchitects.com If lists are not received within 48 hours after bid, no points will be received for this section.

LIST OF PROPOSED SUB-CONTRACTORS/SUPPLIERS

PROJECT: **IDEA PUBLIC SCHOOLS BROWNSVILLE ROBINDALE PHASE I**

BIDDER: _____ DATE: _____

ITEM	NAME OF SUB-CONTRACTOR/SUPPLIER (As applicable)
PERFORMANCE-PAYMENT BONDS	
EARTHWORK	
IRRIGATION	
LANDSCAPING	
TERMITE CONTROL	
CONCRETE WALKS, CURBS AND PAVING	
METAL CANOPIES	
CONCRETE (CAST-IN-PLACE)	
UNIT MASONRY	
STONEWORK	
STRUCTURAL STEEL	
STEEL JOISTS	
STEEL DECKING	
LIGHTGAUGE METAL FRAMING	
METAL FABRICATIONS	
ROUGH CARPENTRY	
ARCHITECTURAL WOOD WORK	
BITUMINOUS WATERPROOFING	
INSULATION	
MODIFIED BITUMINOUS ROOFING SYSTEM	
FLASHING & SHEET METAL	
PREFORMED METAL ROOFING	
JOINT SEALERS	
STEEL DOORS	
FLUSH WOOD DOORS	
ALUMINUM DOORS & FRAMES	
FINISH HARDWARE	
GLAZED ALUMINUM CURTAIN WALL	
GLASS & GLAZING	
ACCESS DOORS	
OVERHEAD GRILLE DOORS	
LATH & PLASTER	
GYPSUM DRYWALL	
TILE	
ACOUSTIC CEILINGS	
RESILIENT FLOORING	
CARPETING	
PAINTING	
TOILET PARTITIONS	
MOBILE STORAGE SHELVING	
DIVISION 10 SPECIALTIES	
DIVISION 11 - EQUIPMENT	
AUDITORIUM SEATING	
DIVISION 15	
HVAC SUBCONTRACTOR	
HVAC EQUIPMENT	
HVAC CONTROLS	
PLUMBING SUBCONTRACTOR	
DIVISION 16	
ELECTRICAL SUBCONTRACTOR	
FIRE ALARM, INTERCOM, INT DET SUBCONTRACTOR	

AIA® Document A201™ – 2007

General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)
Idea Public Schools Brownsville Robindale
Brownsville, Texas

THE OWNER:
(Name, legal status and address)
Idea Public Schools
2115 W. Pike Blvd.
Weslaco, Texas 78596

THE ARCHITECT:
(Name, legal status and address)
Gomez Mendez Saenz, Inc.,
1150 Paredes Line Rd.
Brownsville, Texas 78521

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

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User Notes: (3B9ADA12)

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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 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 and certify termination of the Agreement under Section 14.2.2.

§ 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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§ 1.2.2 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 will retain all common law, statutory and other reserved rights, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment 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 this 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 material or equipment suppliers are authorized to use and reproduce the Instruments of Service provided to them 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 material or equipment suppliers may not use the Instruments of Service on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and the Architect's consultants.

§ 1.6 TRANSMISSION OF DATA IN DIGITAL FORM

If the parties intend to transmit Instruments of Service or any other information or documentation in digital form, they shall endeavor to establish necessary protocols governing such transmissions, unless otherwise already provided in the Agreement or the Contract Documents.

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 INFORMATION AND SERVICES REQUIRED OF THE OWNER

§ 2.2.1 Prior to commencement of the Work, the Contractor may request in writing that the Owner provide reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. Thereafter, the Contractor may only request such evidence if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) a change in the Work materially changes the Contract Sum; or (3) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due. The Owner shall furnish such evidence as a condition precedent to commencement or continuation of the Work or

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the portion of the Work affected by a material change. After the Owner furnishes the evidence, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.2 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.

§ 2.2.3 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.

§ 2.2.4 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.

§ 2.2.5 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.

§ 2.3 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.

§ 2.4 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 written 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 deficiencies. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor 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. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

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 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.

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§ 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 the information furnished by the Owner pursuant to Section 2.2.3, 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 make 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 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, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and 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 written notice to the Owner and Architect and shall not proceed with that portion of the Work without further written instructions from the Architect. If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Owner shall be solely responsible for any loss or damage arising solely from those Owner-required 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

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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 authorized by the Architect in accordance with Sections 3.12.8 or 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.

§ 3.5 WARRANTY

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.

§ 3.6 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 21 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 an equitable adjustment 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 in writing, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may proceed 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

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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.

§ 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 furnish in writing to the Owner through the Architect the name and qualifications of a proposed superintendent. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to the proposed superintendent or (2) that the Architect requires additional time to review. Failure of the Architect to reply 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 SCHEDULES

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall prepare and submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work.

§ 3.10.2 The Contractor shall prepare a submittal schedule, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Architect's approval. The Architect's approval shall not unreasonably be 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, 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.

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§ 3.11 DOCUMENTS AND SAMPLES AT THE SITE

The Contractor shall maintain at the site for the Owner one copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and one copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect and shall be 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 the way by which 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 requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect in writing 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 written 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

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required to provide professional services in violation of applicable law. 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 specify all performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly 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, accuracy and completeness of the services, certifications and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review, 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. The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

§ 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, and 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 and patching shall be restored to the condition existing prior to the cutting, fitting and 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 such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's 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 or 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 Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 ACCESS TO WORK

The Contractor shall provide the Owner and Architect 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 such 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 the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such 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 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.

§ 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.

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

§ 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, except as provided in Section 3.3.1.

§ 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 report to the Owner (1) known deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor, and (2) 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.

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§ 4.2.4 COMMUNICATIONS FACILITATING CONTRACT ADMINISTRATION

Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Architect about matters arising out of or relating to the Contract. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner.

§ 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 13.5.2 and 13.5.3, whether or not such 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, material and equipment 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, unless otherwise specifically stated by the Architect, 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 authorize 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 duties, responsibilities and limitations of authority of such project representatives shall be as set forth in an exhibit to be incorporated in the Contract Documents.

§ 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.

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§ 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 number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a separate contractor or 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 or the bidding requirements, the Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to any such proposed person or entity or (2) that the Architect requires additional time for review. Failure of the Owner or Architect to reply 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 previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 SUBCONTRACTUAL RELATIONS

By appropriate agreement, written where legally required for validity, 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, which the Contractor, by these 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

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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 in writing; and

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

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 such 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 Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Article 15.

§ 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 other separate contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to the 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, the Owner shall be deemed to be subject to the same obligations and to have the same rights that apply to the Contractor 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 report to the Architect apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that

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the Owner's or separate contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable.

§ 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 the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or separate contractors as provided in Section 10.2.5.

§ 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, and the Contractor shall proceed promptly, 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

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.4 As provided in Section 7.3.7.

§ 7.3.4 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed in a proposed Change Order or Construction Change Directive so that application of such unit prices to quantities of Work proposed will cause substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 7.3.5 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.

§ 7.3.6 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.

§ 7.3.7 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the method and 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 7.3.7 shall be limited to the following:

.1 Costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance;

.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 related to the Work; and

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

§ 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 has authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes will be effected by written order signed by the Architect and shall be binding on the Owner and Contractor.

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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.

§ 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, prematurely commence operations on the site or elsewhere prior to the effective date of insurance required by Article 11 to be furnished by the Contractor and Owner. The date of commencement of the Work shall not be changed by the effective date of such insurance.

§ 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 an act or neglect of the Owner or Architect, or of an employee of either, or of a separate contractor employed by the Owner; or by changes ordered in the Work; or by labor disputes, fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor's control; or by delay authorized by the Owner pending mediation and arbitration; or by other causes that the Architect determines may justify delay, then the Contract Time shall be extended by Change Order 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

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.

§ 9.2 SCHEDULE OF VALUES

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit to the Architect, before the first Application for Payment, a schedule of values allocating the entire Contract Sum to the various portions of the Work and prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's 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. Such application shall be notarized, if required, and supported by such data substantiating the Contractor's right to payment as the Owner or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and shall reflect retainage if provided for in the Contract Documents.

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§ 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 material supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 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, material suppliers, or other persons or entities making a claim by reason of having 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 issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect's reasons for withholding certification in whole or in part 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 comprising the Application for Payment, that, to the best of the Architect's knowledge, information and belief, the Work has progressed to the point indicated and that the quality of the Work is in accordance with the Contract Documents. 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. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. 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 material 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;

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.3 failure of the Contractor to make payments properly to Subcontractors or 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

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

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

§ 9.5.3 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 material or equipment suppliers 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 Architect will reflect such payment on the next Certificate 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 material and equipment 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 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, except as may otherwise be required by law.

§ 9.6.5 Contractor payments to material and equipment 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 and 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, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 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' written notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended

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appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shut-down, 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, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall 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 such Certificate. Upon such acceptance and consent of surety, if any, the Owner shall make payment of retainage applying to such 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 as required under Section 11.3.1.5 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.

§ 9.10 FINAL COMPLETION AND FINAL PAYMENT

§ 9.10.1 Upon receipt of the Contractor's written 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 and, when the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect

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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 terms and conditions of 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 and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner, (3) a written statement that the Contractor knows of no substantial 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 and (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, 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. If such lien 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 such lien, 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 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 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; or

.3 terms of special warranties required by the Contract Documents.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor or material 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;

.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 or the Contractor's Subcontractors or Sub-subcontractors; 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.

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§ 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 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 owners and users of adjacent sites and utilities.

§ 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, except damage or loss 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, written notice of such 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

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials. 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 report the condition to the Owner and Architect in writing.

§ 10.3.2 Upon receipt of the Contractor's written 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 such material or substance or who are to perform the task of removal or safe containment of such 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 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 in the amount of the Contractor's reasonable additional costs of shut-down, delay and start-up.

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§ 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 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 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 indemnify the Owner for the cost and expense the Owner incurs (1) for remediation of a material or substance 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 indemnify 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 LIABILITY INSURANCE

§ 11.1.1 The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations and completed operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

.1 Claims under workers' compensation, disability benefit and other similar employee benefit acts that are applicable to the Work to be performed;

.2 Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;

.3 Claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;

.4 Claims for damages insured by usual personal injury liability coverage;

.5 Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom;

.6 Claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;

.7 Claims for bodily injury or property damage arising out of completed operations; and

.8 Claims involving contractual liability insurance applicable to the Contractor's obligations under Section 3.18.

§ 11.1.2 The insurance required by Section 11.1.1 shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from the date of commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment, and, with respect to the Contractor's completed operations coverage, until the expiration of the period for correction

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of Work or for such other period for maintenance of completed operations coverage as specified in the Contract Documents.

§ 11.1.3 Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work and thereafter upon renewal or replacement of each required policy of insurance. These certificates and the insurance policies required by this Section 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment as required by Section 9.10.2 and thereafter upon renewal or replacement of such coverage until the expiration of the time required by Section 11.1.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness.

§ 11.1.4 The Contractor shall cause the commercial liability coverage required by the Contract Documents to include (1) the Owner, the Architect and the Architect's consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations.

§ 11.2 OWNER'S LIABILITY INSURANCE

The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

§ 11.3 PROPERTY INSURANCE

§ 11.3.1 Unless otherwise provided, the Owner shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance written on a builder's risk "all-risk" or equivalent policy form in the amount of the initial Contract Sum, plus value of subsequent Contract Modifications and cost of materials supplied or installed by others, comprising total value for the entire Project at the site on a replacement cost basis without optional deductibles. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 11.3 to be covered, whichever is later. This insurance shall include interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Project.

§ 11.3.1.1 Property insurance shall be on an "all-risk" or equivalent policy form and shall include, without limitation, insurance against the perils of fire (with extended coverage) and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, falsework, testing and startup, temporary buildings and debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for Architect's and Contractor's services and expenses required as a result of such insured loss.

§ 11.3.1.2 If the Owner does not intend to purchase such property insurance required by the Contract and with all of the coverages in the amount described above, the Owner shall so inform the Contractor in writing prior to commencement of the Work. The Contractor may then effect insurance that will protect the interests of the Contractor, Subcontractors and Sub-subcontractors in the Work, and by appropriate Change Order the cost thereof shall be charged to the Owner. If the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain insurance as described above, without so notifying the Contractor in writing, then the Owner shall bear all reasonable costs properly attributable thereto.

§ 11.3.1.3 If the property insurance requires deductibles, the Owner shall pay costs not covered because of such deductibles.

§ 11.3.1.4 This property insurance shall cover portions of the Work stored off the site, and also portions of the Work in transit.

§ 11.3.1.5 Partial occupancy or use in accordance with Section 9.9 shall not commence until the insurance company or companies providing property insurance have consented to such partial occupancy or use by endorsement or

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otherwise. The Owner and the Contractor shall take reasonable steps to obtain consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse or reduction of insurance.

§ 11.3.2 BOILER AND MACHINERY INSURANCE

The Owner shall purchase and maintain boiler and machinery insurance required by the Contract Documents or by law, which shall specifically cover such insured objects during installation and until final acceptance by the Owner; this insurance shall include interests of the Owner, Contractor, Subcontractors and Sub-subcontractors in the Work, and the Owner and Contractor shall be named insureds.

§ 11.3.3 LOSS OF USE INSURANCE

The Owner, at the Owner's option, may purchase and maintain such insurance as will insure the Owner against loss of use of the Owner's property due to fire or other hazards, however caused. The Owner waives all rights of action against the Contractor for loss of use of the Owner's property, including consequential losses due to fire or other hazards however caused.

§ 11.3.4 If the Contractor requests in writing that insurance for risks other than those described herein or other special causes of loss be included in the property insurance policy, the Owner shall, if possible, include such insurance, and the cost thereof shall be charged to the Contractor by appropriate Change Order.

§ 11.3.5 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, the Owner shall waive all rights in accordance with the terms of Section 11.3.7 for damages caused by fire or other causes of loss covered by this separate property insurance. All separate policies shall provide this waiver of subrogation by endorsement or otherwise.

§ 11.3.6 Before an exposure to loss may occur, the Owner shall file with the Contractor a copy of each policy that includes insurance coverages required by this Section 11.3. Each policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to this Project. Each policy shall contain a provision that the policy will not be canceled or allowed to expire, and that its limits will not be reduced, until at least 30 days' prior written notice has been given to the Contractor.

§ 11.3.7 WAIVERS OF SUBROGATION

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, and (2) the Architect, Architect's consultants, separate contractors described in Article 6, 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 covered by property insurance obtained pursuant to this Section 11.3 or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by the Owner as fiduciary. The Owner or Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described in Article 6, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

§ 11.3.8 A loss insured under the Owner's property insurance 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 11.3.10. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner.

§ 11.3.9 If required in writing by a party in interest, the Owner as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Owner's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Owner shall deposit in a separate account proceeds so received, which the

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Owner shall distribute in accordance with such agreement as the parties in interest may reach, or as determined in accordance with the method of binding dispute resolution selected in the Agreement between the Owner and Contractor. If after such loss no other special agreement is made and unless the Owner terminates the Contract for convenience, replacement of damaged property shall be performed by the Contractor after notification of a Change in the Work in accordance with Article 7.

§ 11.3.10 The Owner as fiduciary shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within five days after occurrence of loss to the Owner's exercise of this power; if such objection is made, the dispute shall be resolved in the manner selected by the Owner and Contractor as the method of binding dispute resolution in the Agreement. If the Owner and Contractor have selected arbitration as the method of binding dispute resolution, the Owner as fiduciary shall make settlement with insurers or, in the case of a dispute over distribution of insurance proceeds, in accordance with the directions of the arbitrators.

§ 11.4 PERFORMANCE BOND AND PAYMENT BOND

§ 11.4.1 The Owner shall have the right to require the Contractor to furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract.

§ 11.4.2 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.

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, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner's expense. If such Work is not in accordance with the Contract Documents, such costs and the cost of correction shall be at the Contractor's expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

§ 12.2 CORRECTION OF WORK

§ 12.2.1 BEFORE OR AFTER SUBSTANTIAL COMPLETION

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, whether discovered before or after 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 an 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 written 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 2.4.

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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, whether completed or partially completed, of the Owner or separate contractors 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 except that, 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 such 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 such assignment.

§ 13.3 WRITTEN NOTICE

Written notice shall be deemed to have been duly served if delivered in person to the individual, to a member of the firm or entity, or to an officer of the corporation for which it was intended; or if delivered at, or sent by registered or certified mail or by courier service providing proof of delivery to, the last business address known to the party giving notice.

§ 13.4 RIGHTS AND REMEDIES

§ 13.4.1 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.

§ 13.4.2 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 there under, except as may be specifically agreed in writing.

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§ 13.5 TESTS AND INSPECTIONS

§ 13.5.1 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 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 (1) tests, inspections or approvals that do not become requirements until after bids are received or negotiations concluded, and (2) tests, inspections or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor.

§ 13.5.2 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 13.5.1, 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 13.5.3, shall be at the Owner's expense.

§ 13.5.3 If such procedures for testing, inspection or approval under Sections 13.5.1 and 13.5.2 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.

§ 13.5.4 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.

§ 13.5.5 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.

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

§ 13.6 INTEREST

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at such rate as the parties may 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.

§ 13.7 TIME LIMITS ON CLAIMS

The Owner and Contractor shall commence all claims and causes of action, whether in contract, tort, breach of warranty or otherwise, against the other arising out of or related to the Contract in accordance with the requirements of the final dispute resolution method selected in the Agreement within the time 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 13.7.

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 or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, 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;

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.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 promptly, upon the Contractor's request, reasonable evidence as required by Section 2.2.1.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, 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' written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, including reasonable overhead and profit, costs incurred by reason of such termination, and damages.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' written 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 for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;

.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 above reasons exist, the Owner, upon certification by the Initial Decision Maker that sufficient cause exists to justify such action, 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' written 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.

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§ 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 as described in 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 written 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 Contractor shall be entitled to receive payment for Work executed, and costs incurred by reason of such termination, along with reasonable overhead and profit on the Work not executed.

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, 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.

§ 15.1.2 NOTICE OF CLAIMS

Claims by either the Owner or Contractor must be initiated by written 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 must 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 CONTINUING CONTRACT PERFORMANCE

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. The Architect will prepare Change Orders and issue Certificates for Payment in accordance with the decisions of the Initial Decision Maker.

§ 15.1.4 CLAIMS FOR ADDITIONAL COST

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

§ 15.1.5 CLAIMS FOR ADDITIONAL TIME

§ 15.1.5.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, written notice as provided herein 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.

§ 15.1.5.2 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.

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§ 15.1.6 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

.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 15.1.6 shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 INITIAL DECISION

§ 15.2.1 Claims, excluding those arising under Sections 10.3, 10.4, 11.3.9, and 11.3.10, 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 arising prior to the date final payment is due, unless 30 days have passed after the Claim has been referred to the Initial Decision Maker with no 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 such 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 an initial decision, demand in writing that the other party file for mediation within 60 days of the initial decision. If such a demand is made and the party receiving the demand fails to file for mediation within the time required, 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 15.1.6 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 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. 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 Either party, at its sole discretion, may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party 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 Either party, at its sole discretion, 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

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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 the Owner and Contractor under this Agreement.

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SUPPLEMENTARY CONDITIONS
TO THE GENERAL CONDITIONS OF THE CONTRACT
FOR CONSTRUCTION
IDEA PUBLIC SCHOOLS

The Supplementary Conditions contain modifications and additions to the General Conditions of the Contract for Construction, AIA Document A201, 2007 Edition. Where any part of the AIA General Conditions is modified or voided by the Supplementary Conditions, the unaltered portions shall remain in effect. The paragraph numbering system of AIA Document A-201, 2007 Edition, is continued in the Supplementary Conditions.

ARTICLE 1 – GENERAL PROVISIONS

1.1 Basic Definitions

1.1.1 The Contract Documents

1.1.1 In line 6, after "Architect" delete "." and insert "pursuant to Paragraph 7.4." In line 6 delete "Unless specifically enumerated in the Agreement" and replace with, "At the Owner's option,"

Insert new 1.1.1.1 as follows:

1.1.1.1 Contractor acknowledges and warrants that it has closely examined all the Contract Documents and is unaware of any instance where the documents are not suitable or are insufficient, to enable the Contractor to complete the Work in a timely manner for the Contract sum, and that they include all Work, whether or not shown or described, which reasonably may be inferred or useful for the completion of the Work in full compliance with all applicable codes, laws, ordinances, and regulations."

1.1.2 The Contract

1.1.2 In line 5 after "Sub-Subcontractor" insert the following, "(except as provided in Paragraph 5.3 and 5.4 hereof)". In line 7 after "obligations" insert "of Contractor".

1.1.3 The Work

Insert new 1.1.3.1 as follows:

1.1.3.1 The Work shall include the obligation of the Contractor to visit the site of the project before submitting a proposal. Such site visit shall be for the purpose of familiarizing Contractor with the conditions as they exist and the character of the operations to be carried on under the Contract Document, including all existing site conditions, access to the site, physical characteristics of the site and surrounding areas. It also includes all supplies, skill, supervision, transportation services and other facilities

and things necessary, proper or incidental to the carrying out and completion of the terms of the Contract and all other items of cost or value needed to produce, construct and fully complete the public work identified by the Contract Documents.

1.1.5 The Project

1.1.5 At the end of the paragraph delete the "." and insert the following, "wherever located and whenever issued."

1.2 Correlation and Intent of the Contract Documents

1.2.1 At the end of the paragraph insert the following, "Any differences between the requirements of the Drawings and the Specifications or any differences noted within the Drawings themselves or within the Specifications themselves have been referred to Owner and Architect by Contactor prior to the submission of bids and have been clarified by a Addendum issued to all bidders."

"If such differences or conflicts were not called to Owner's and Architect's attentions prior to submission of bids, Architect shall decide which of the conflicting requirements will govern based upon the following: the most stringent of the requirements will take precedence over the less stringent; the most expensive item will take precedence over the less expensive, and subject to the approval of Owner, Contractor shall perform the Work at no additional cost and/or time to Owner in accordance with the Architect's decision. Work not covered in the Contract Documents will not be required unless it is consistent therewith and is reasonably inferable as being necessary to produce the intended results."

Insert new 1.2.1.1 as follows:

1.2.1.1 In the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following priorities:

.1 The Agreement;
.2 Addenda, with those of later date having precedence over those of earlier date;
.3 Supplemental Conditions;
.4 The General Conditions of the Contact for Construction;
.5 Specifications;
.6 Drawings, in the case of inconsistency between the Drawings and Specifications or within either document, not clarified by Addendum, the better quality or greater quantity of Work shall be included in the Contract Documents. Clarifications of the inconsistency will be accomplished with the Contractor and, if necessary, an appropriate reduction in the contract will be accomplished by Change Order. Figures given on drawings govern scale measurements. Large scale drawings take precedence over small scale drawings. Written word take precedence over numbers.

Handwritten documents take precedence over typewritten documents. Existing conditions take precedence over drawings and specifications for dimensions and shall be verified by the Contractor. The Contractor proceeds at his own risk if conflicts or discrepancies are not resolved prior to the execution of the Work.

Insert new 1.2.1.2 as follows:

1.2.1.2 If Work is required in a manner to make it impossible to produce Work of the quality required by or reasonably inferred from the Contract Documents, or should discrepancies appear among the Contract Documents, Contractor shall request in writing an interpretation from Architect before proceeding with the Work. If Contractor fails to make such request, no excuse will thereafter be entertained for failure to carryout Work in the required manner or provide required guarantees, warranties, or bonds, and Contractor shall not be entitled to any change in the Contract Sum or the Contract Time on account of such failure.

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

1.5.1 Delete the first sentence in its entirety and replace with the following, "Instruments of Service, including the Drawings, Specifications, and other similar or related documents and copies thereof are furnished to Contractor for the purpose of performing the Work and are, and shall remain, the property of Owner and Owner will retain all common law, statutory and other reserved rights, including copyrights." In line 6 delete, "Architect or Architect's consultants'" and replace with, "Owner or Owners' consultants . Add the following at the end of the paragraph "Neither the Contractor nor any subcontractor may utilize the Instruments of Service on other projects without the written consent of the Owner and the Architect."

ARTICLE 2 – OWNER

2.1 General

Delete the existing Paragraph 2.1.1 and replacing it with the following paragraph:

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. IDEA Public Schools Board of Trustees has designated the Chief Executive Officer, Chief Operating Officer, and Chief Financial Officer, with the power to enter into a Contract, to execute a change order requiring an increase in the Contract Sum, or agreements to extend the contractual completion date. Project Management Services, Inc. (may be referred to as "Project Manager"), is an authorized representative to act on its behalf during the course of construction and any decisions made by the Project Manager effecting cost or extensions of contract

time must be ratified by one of the IDEA Public Schools Chief Officers.

2.1.2 Delete in its entirety.

2.2 Information and Services Required by Owner

2.2.3 In line 1 after, "characteristics" insert "and" and delete "and utility locations". At the end of the paragraph insert the following, "In connection with the foregoing, Contractor shall be solely responsible for locating (and shall locate prior to performing any Work) all utility lines, telephone company lines and cable, sewer lines, water pipes, gas lines, electrical lines, including without limitation, all buried pipelines and buried telephone cables an shall perform the Work in such a manner so as to avoid damaging any such lines, cables, pipes and pipelines"

2.2.5 At the end of the sentence delete the "." and insert the following, "for use on this Project. All costs of reproduction are the responsibility of Contactor."

2.3 Owner's Right to Stop the Work

2.3 In line two after, "Contract Documents" insert the following, "or fails to remove and discharge (within ten (10) days) any lien filed upon Owner's or Landlord's property by anyone claiming by, through, or under Contractor; or disregards the instructions of Architect or Owner when based on the requirements of the Contract Documents". At the end of the paragraph delete "." and insert the following, ", and any delay resulting from such Work stoppage shall not extend any Milestone Date identified in the Contract for Construction or the required dates of Substantial or Final Completion."

2.4 Owner's Right to Carry Out the Work

Insert new 2.4.1 as follows:

2.4.1 The rights stated in Article 2 shall be in addition and not in limitation of any other rights of Owner granted in the Contract Documents or at law or in equity.

INSERT NEW 2.5 and 2.5.1:

2.5 For any charges submitted for payment based upon costs incurred by the Contractor, the Owner shall be entitled to audit all records of the Contractor to verify the accuracy of costs. This right of audit will extend for three years after final completion, and the Contractor will maintain records reflecting all costs for this period and promptly provide access to the Owner upon request.

2.5.1 In no event shall the Owner have control over, change of, or any responsibility for construction, means, methods, techniques, sequences or procedures or for safety precautions and programs in connection with the Work, notwithstanding any of the rights and authority granted the Owner in the Contract Documents.

ARTICLE 3 – CONTRACTOR

3.2 Review of Contract Documents and Field Conditions by Contractor

3.2.2 In line 7 after "Architect" insert "and Owner" and in line 8 after "request for" insert, "design". Delete the last sentence in its entirety.

3.2.3 In line 3 after "Architect" insert, "and Owner in writing," and in line 4 after "request for" insert "design."

3.2.4 Delete the "." at the end of the paragraph and insert the following, "unless the Contractor recognized or reasonably should have recognized such error, inconsistency, omission or difference and knowingly failed to report it to the Architect and Owner."

Insert new paragraphs 3.2.5, 3.2.6, 3.2.7 and 3.2.8 as follows:

3.2.5 "The Contractor shall not be entitled to additional compensation for the "rework portion" of any additional work caused by his failure to carefully study and compare the Contract Documents prior to execution of the Work."

3.2.6 "The Contractor shall make reasonable attempt to interpret the Contract Documents before asking the Architect for assistance in interpretation. The Contractor shall not ask the Architect for observation of work prior to the Contractor's field superintendent's personal inspection of the work and his determination that the work complies with the Contact Documents."

3.2.7 "If, in the opinion of the Architect and Owner, the Contractor does not make a reasonable effort to comply with the above requirements of the Contract Documents and this causes the Architect or his consultants to expend an unreasonable amount of time in the discharge of the duties imposed on him by the Contract Documents, then the Contractor shall bear the cost of compensation for the Architect's additional services made necessary by such failure. The Architect will give the Contractor prior notice of intent to bill for additional services related to 3.2.6, 3.2.7 and 3.12 before additional services are performed."

3.2.8 If the Contractor has knowledge that any of the products or systems specified will perform in a manner that will limit the Contractor's ability to satisfactorily perform the work or to honor his Warranty, Contractor shall promptly, but no later than three (3) business days after having such knowledge, notify the Architect in writing, providing substantiation for the position. Any necessary changes, including substitutions of materials, shall be accomplished by appropriate Modification.

3.3 Supervision and Construction Procedures

3.3.1 Delete the last sentence in its entirety.

Insert new 3.3.4, 3.3.5, 3.3.6, 3.3.7, 3.3.8, 3.3.9, 3.3.10, 3.3.11 as follows:

3.3.2 Add the following to the end of the paragraph:

As part of that responsibility, Contractor shall enforce the Owner's alcohol-free, drug-free, tobacco-free, and weapon-free policies and zones, which will require compliance with those policies and zones by Contractor's employees, Subcontractors, and all other persons carrying out the Contract. Contractor shall also require adequate and appropriate dress of Contractor's employees, Subcontractors, and all other persons carrying out the Contract.

As to those matters for which the Contractor has responsibility under the terms of the Agreement, the Owner shall not be responsible for or have control or charge over the acts or omissions of the Contractor, Subcontractors or any of their agents or employees or any other persons for whom Contractor is responsible. It is understood and agreed that the relationship of Contractor to Owner shall be that of an independent contractor. Nothing contained herein of inferable herefrom shall be deemed or construed (1) to make Contractor the agent, servant, or employee of the Owner or (2) create any partnership, joint venture or other association between Owner and Contractor. Any direction or instruction by Owner or any of its authorized representatives in respect of the Work shall related to the results the Owner desires to obtain from the Work, and shall in no way affect Contractor's independent contractor status as described herein.

3.3.4 Contractor shall be responsible to Owner for acts and omissions of Contractor's employees, Subcontractors and their agents and employees, and other persons performing portions of the Work under Contract Documents or other arrangements with Contractor.

3.3.5 Contractor shall give notices and comply with applicable laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on the Work, including those with respect to the safety of persons and property and their protection from damages, injury, or loss. Contractor shall promptly, but no later than 5 days, remedy damage and loss to property at the site caused in whole or in part by Contractor, its Subcontractor, or anyone directly or indirectly employed by any of them or by anyone for whose acts they may be liable, except for damage or loss attributable solely to acts or omissions of Owner or Architect or by anyone for whose acts either of them may be liable and not attributable to the fault or negligence of Contractor, its Subcontractor, or anyone directly or indirectly employed by them. The foregoing obligations of Contractor are in addition to Contractor's obligations under other provisions hereunder.

3.3.6 Contractor shall be responsible for inspection of portion of Work already performed under the Contract for Construction to determine that such portions are in proper condition to receive subsequent Work.

3.3.7 Contractor has the responsibility to ensure that all material suppliers and Subcontractors, their agents, and employees adhere to the Contract Documents, and that they order materials on time, taking into account the current market and delivery conditions, and that they provide materials on time. Contractor shall coordinate its Work with that of all others on the Project, including of construction utilities.

3.3.8 Contractor shall establish and maintain bench marks and all other grades, lines, and levels necessary for the Work; report errors or inconsistencies to Owner and Architect before commencing Work; and, if applicable, review the placement of the buildings and permanent facilities on the site with Owner and Architect after all lines are staked out and before foundation Work is started. Contractor shall provide access to the Work for Owner, Architect, other persons designated by Owner, and governmental inspectors. Any encroachments made by Contractor or its Subcontractors on adjacent properties caused by construction as revealed by an improvements survey, except for encroachments arising from errors or omissions not reasonably discoverable by Contractor in the Contract Documents, shall be the sole responsibility of Contractor, and Contractor shall correct such encroachments within thirty (30) days of the improvement survey (or as soon thereafter as reasonably possible), at Contractor's sole cost and expense, either by the removal of the encroachment (and subsequent reconstruction on the Project site) or agreement with the adjacent property Owner(s) (in form and substance satisfactory to Owner in its sole discretion) allowing the encroachments to remain.

3.3.9 Contractor shall verify at the Work site the measurements indicated on the Drawings and Specifications and shall establish correctly the lines, levels, and positions for the Work and be responsible for their accuracy and proper correlation with control lines, monuments, and data, as established by surveys furnished by Owner. Work shall be erected square, plumb, level, true to line and grade, in the exact plane and to the correct elevation and/or sloped to drain as indicated. To ensure the proper execution of its subsequent Work, Contractor shall measure all Work already in place (including but not limited to utilities and grades installed or prepared by others) and shall at once report to Architect and Owner any discrepancy between said Work and the Drawings and Specifications for the Work.

3.3.10 Any discrepancy or omission in the dimensions or elevations shown on the Drawings and Specifications or found in previous Work which may prevent accurate layout or construction of the Work, shall immediately be reported by Contractor to Owner and Architect. If Contractor performs, permits, or causes performance of any Work when Contractor knows or reasonably should have known that such discrepancy or omission exists, without first obtaining further instruction from Architect or Owner, Contractor shall bear any and all costs arising therefrom including, without limitation, the costs of correction thereof without increase or adjustment in the Contract Sum. Omissions from the Drawings or Specifications, or the misdescription of details of Work which are reasonably inferable in order to carry out the intent of the Drawings and Specifications, or which are customarily performed, shall not relieve Contractor from

performing such omitted or mis-described details of the Work, and they shall be performed as if fully and correctly set forth and described in the Drawings and Specifications, at no additional cost to Owner.

3.3.11 Contractor shall engage workers who are skilled in performing the Work, and all Work shall be performed with care and skill and in a good workmanlike manner under the full-time supervision of an approved engineer or foreman. Contractor shall be liable for all property damage, including repairs and replacements of the Work and economic losses, which proximately result from the breach of this duty. Contractor shall advise Architect:

1. if a specified product deviates from good construction practices;

2. if following the Specifications will affect any warranties; or

3. any objections which Contractor may have to the Specifications.

Nothing contained in Subparagraph 1.1.3 shall alter the responsibilities established in this Subparagraph.

3.4 Labor and Materials

3.4.2 At the end of the paragraph delete the "." and insert the following, "by making requests for substitutions based on Subparagraph 3.4.2, Contractor:

.1 represents that Contractor has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified;

.2 represents that Contractor will provide the same warranty for the substitution that Contractor would for that specified;

.3 certifies that the cost data presented is complete and includes all related costs under this Contract except Architect's redesign costs, and waives all claims for additional costs related to the substitution which subsequently become apparent; and

.4 will coordinate the installation for the accepted substitute, making such changes as may be required for the Work to be complete in all respects.

Add the following at the end of the paragraph: "Contractor shall bear the risk of any delay in performance caused by submitting substitutions."

3.4.3 At the end of the paragraph insert the following, "Contractor shall also be responsible for labor peace on the Project and shall at all times make its best efforts and judgments as an experienced Contractor to adopt and implement policies and practices designed to avoid Work stoppages, slowdowns, disputes, or strikes where reasonably possible and practical under the circumstances and shall at all times maintain Project-wide labor harmony. Except as specifically provided in Subparagraph 8.3 hereof, Contractor shall be liable to Owner for all damages suffered by Owner."

Insert new 3.4.4, 3.4.5 and 3.4.6 as follows:

3.4.4 Materials shall conform to manufacturer's standards in effect at the date of execution of the Agreement and shall be installed in strict accordance with manufacturer's directions. Contractor shall, if required by Owner or Architect, furnish satisfactory evidence as to the kind and quality of any materials. All packaged materials shall be shipped to the site in the original containers clearly labeled, and delivery slips shall be submitted with bulk materials identifying thereon the source, and warranting quality and compliance with Contract Documents.

3.4.5 When the Contract Documents require the Work, or any part of same, to be above the standards required by applicable laws, ordinances, rules and regulations, and other statutory provisions pertaining to the Work, such Work shall be performed and completed by Contractor in accordance with the Contract Documents.

3.4.6 When the manufacturer's name, patent numbers, underwriter's labels, model numbers or similar identifying marks are required, such markings shall be located as inconspicuously as possible.

Add new 3.4.7

3.4.7 Contractor agrees that it and its agents and employees will comply with the Immigration Reform and Control Act of 1986, as amended by the Immigration Act of 1990, or any subsequent legislation which regulates the employment of aliens. Contractor will not knowingly employ or knowingly allow any of its Subcontractors to employ, any illegal or undocumented aliens to perform any Work in connection with the Project. Contractor will retain and make available for inspection by Owner at the Contractor's Primary place of business, ~~Project site (and if requested provide a copy to Owner),~~ on the first day of employment or upon reasonable notice, a completed I-9 Employment Eligibility Verification Form and copies of associated employment eligibility and identity documentation for each person that Contractor directly employs on the jobsite. If Contractor receives actual knowledge of the unauthorized status of one of its jobsite employees, or if Contractor learns of facts that would lead a reasonable person to infer the unauthorized status of any jobsite employee, Contractor will immediately remove that employee from the jobsite, inform Owner, and shall require such Subcontractor to act in a similar fashion with respect to such Subcontractor's employees. Contractor agrees to have a provision on its subcontracts stating that each Subcontractor will have the duties and responsibilities with regard to its employees that the Contractor has agreed to in this section. The Contractor agrees to defend (at Owner's option, and with counsel acceptable to Owner), indemnity and hold harmless the Owner as to any fines or other liabilities of any kind arising out of or relating to Contractor's breach of this section or any immigration laws or regulations.

3. 5 Warranty

3.5.1 In line 2, delete "good" and substitute "the best". In line 4 delete "except for those inherent in the quality of the Work that Contact Documents require or permit." Delete the fourth sentence in its entirety. In the line 8 after "Architect" add "or Owner".

After 3.5.1 insert the following new paragraphs:

3.5.2 ALL WARRANTIES SHALL INCLUDE LABOR AND MATERIALS AND THE MANUFACTURER'S WARRANTY SHALL BE SIGNED BY SUBCONTRACTOR AND COUNTERSIGNED BY CONTRACTOR. ALL WARRANTIES SHALL BE ADDRESSED TO OWNER AND DELIVERED TO ARCHITECT UPON COMPLETION OF THE WORK AND BEFORE OR WITH THE SUBMISSION OF REQUEST FOR FINAL PAYMENT.

3.5.3 Contractor shall issue in writing to Owner as a condition precedent to final payment a "general warranty" reflecting the terms and conditions of this Paragraph 3.5 for all Work under the Contract.

3.5.4 The warranties provided in Paragraph 3.5 shall be in addition to and not in limitation of any other warranty or remedy required by law or by the Contract Documents, and such warranty shall be interpreted to require Contractor to replace defective materials and equipment and re-execute defective Work which is disclosed to the Contractor by the Owner within a period of one (1) year after final completion of the entire Work unless a longer time is specifically called for in the specifications. The Contractor shall assign all components, equipment and fixture warranties to the Owner and will deliver all manuals to the Owner at the completion of construction.

3.5.5 Except when a longer warranty time is specifically called for in the Specification Sections or is otherwise provided by law, the General Warranty shall be for twelve (12) months and shall be in form and content otherwise satisfactory to Owner.

3.5.6 Warranties shall become effective on a date established by Owner and Architect in accordance with the Contract Documents. This date shall be the Date of Substantial Completion of the entire Work, unless otherwise provided in any Certificate of Partial Substantial Completion approved by the parties.

3.5.7 If Architect considers it impractical, because of unsuitable test conditions or some other factors, to execute simultaneous final acceptance of all equipment, portions of the installation may be certified by Architect for final acceptance, subject to Owner's approval, when that portion of the system is complete and ready for operation as called for under Subparagraph 9.8.1.

3.5.8 Contractor shall warrant for a period of twelve (12) months that the building(s) shall be watertight and leak proof at every point and in every area, except where leaks can be attributed to damage to the building(s) by external forces beyond Contractor's control. Contractor shall, immediately upon notification by Owner of water penetration, determine the source of water penetration and, at its own expense, do any Work

necessary to make the building(s) watertight. Contractor shall also, at its own expense, repair or replace any other damaged material, finishes, and furnishings, damaged as a result of this water penetration, to return the building(s) to its (their) original condition.

3.5.9 In addition to the foregoing stipulations, Contractor shall comply with all other warranties referred to in any portions of the Contract Documents or otherwise provided by law or in equity, and where warranties overlap, the more stringent requirement shall govern.

3.5.10 If for any reason Contractor cannot warrant any part of the Work using material or construction methods that have been specified, or shown, it shall notify Owner and Architect in writing before the Contract is signed, giving reasons, together with the name of product and data on a substitution it can warrant.

3.6 Taxes

Add the following paragraph:
The Owner is exempt from the Texas Sales Tax on any purchase of tangible personal property and will issue Certificates of Exemption from the Texas Sales Tax on materials furnished by Contractors on School Construction projects.

3.7 Permits, Fees, Notices and Compliance with Laws

3.7.1 In line 1 after "the Contractor shall" insert the following, "make application,". In line 3 after "Contract" delete "and" and insert the following, "including, without limitation, street openings, sidewalk, and other obstructions, access over public ways and storage necessary for proper execution of the Contract and which are".

Insert new 3.7.1.1 as follows:

3.7.1.1 The Contractor shall also obtain all permits and approvals, and pay all fees and expenses, if any, associated with National Pollutant Discharge Elimination System (NPDES) regulations administered by the Environmental Protection Agency and state and local authorities, that require completion of documentation and/or acquisition of all permits for the Project. Contractor's obligations under this paragraph do not require it to perform engineering services during the pre-construction phase to prepare proper drainage for the construction sites. However, any drainage alterations made by Contractor during construction phase which modifies the original site drainage plan and requires the issuance of a permit shall be at Contractor's sole cost.

a. The Owner shall pay directly to the governing authority the cost of all permanent property utility assessments and similar utility connection charges.

b. The Contractor shall be responsible for obtaining and paying for all City and County Building Permits, Inspection Fees and Plan Checking Fees; temporary

utility charges, tap charges and water meter charges and any other similar fees assessed by jurisdictional authorities having control over the Project.

3.7.2 In line 2 after "lawful orders" insert "and all other requirements".

3.7.3 In line 1 after "Work" insert, "(including, without limitation, the installation of any materials or equipment) that it knows or reasonably should have known would" and also in line 1 delete "knowing it to be."

3.7.4 In line 8 after "will recommend" insert "to the Owner in writing,". At the end of the paragraph insert the following, "No adjustment in the Contract Time or Contract Sum shall be permitted in connection with a concealed or unknown condition that does not differ materially from those conditions disclosed or based on data provided to Contractor and by the Contractor's prior inspections, tests, reviews, and pre-construction services for the Project; or by the Contractors inspections, tests, reviews and pre-construction services that Contractor had the opportunity and obligation to make in connection with the Project but did not do so.

3.7.5 In line 3 after "Owner and Architect" insert "in writing".

3.8 Allowances

3.8.3 At the end of the sentence insert the following, "If a decision is needed to avoid a delay, Contractor shall notify Architect and Owner in writing sufficiently in advance of needed date to allow reasonable time for selections to be made."

3.9 Superintendent

3.9.2 Delete the second and third sentences in their entirety and insert the following in lieu thereof, "The Superintendent shall be satisfactory to the Owner and shall not be changed except with the consent of the Architect, unless the Superintendent leaves the employment of the Contactor. No increase in Contract Time or Contract Sum shall be allowed in the event the Owner or Architect objects to any nominated superintendent. Such approval by the Owner shall not be unreasonably withheld."

3.9.3 Delete in its entirety and replace with the following paragraphs:

3.9.3 Superintendent shall become resident on the site as soon as possible after commencement of the Work, and shall remain assigned to this Work, and resident on the site, throughout the course of the Work until items requiring completion or correction, identified at Substantial Completion, have been completed or corrected.

3.9.4 Project manager, while not required to be resident at the site, shall remain assigned to this Work, and be available on an as-needed basis throughout the course of the Work until items requiring completion or correction, identified at

Substantial Completion, have been completed or corrected.

3.9.5 Owner shall be notified not less than 24 hours before any time superintendent will not be resident at the site for any reason except periodic illness; if the reason is due to illness, Owner shall be notified at the beginning of that day. Owner shall be notified of the identity of the acting superintendent. In the event the superintendent is absent from the site and notice has not been provided nor has an acting superintendent been assigned to the Work, then the Contractor is subject to being backcharged in the amount of $250.00 for each occurrence.

3.10 Contractor's Construction Schedules

3.10.1 In line 2 delete "information" and insert "review and approval". In line 3 after "revised at" insert "as required herein and". At the end of the paragraph insert the following, "The schedule shall indicate the proposed starting and completion dates for the various subdivisions of the Work as well as the totality of the Work. The schedule shall be updated every thirty (30) days and submitted to Architect with Contractor's Applications for Payment. Each schedule shall contain a comparison of actual progress with the estimated progress for such point in time stated in the original schedule. If any schedule submitted sets such a date for Substantial Completion for the Work or any phase of the Work beyond the date(s) of Substantial Completion established in the Contract (as the same may be extended as provided in the Contract Documents), then Contractor shall submit to Architect and Owner for their review and approval a narrative description of the means and methods that Contractor intends to employ to expedite the progress of the Work to ensure timely completion of the various phases of the Work as well as the totality of the Work. To ensure such timely completion, Contractor shall take all necessary action including, without limitation, increasing the number of personnel and labor on the Project and implementing overtime and double shifts. In that event, Contractor shall not be entitled to an adjustment in the Contract Sum or the schedule.

3.10.2 In line 2 after "for the Architect's" insert "and Owner's" In line 3 after "Architect's" insert "and Owner's"

After 3.10.3 insert new 3.10.4 and 3.10.5 as follows:

3.10.4 The process of approving Contractor's schedules and updates to Contractor's schedule shall not constitute a warranty by the Owner that any non-Contractor milestones or activities will occur as set out on Contractor's schedule. Approval of a Contractor's schedule does not constitute a commitment by the Owner to furnish any Owner-furnished information or material any earlier than Owner would otherwise be obligated to furnish that information or material under the Contract Documents. Failure of the Work to proceed in the sequence scheduled by Contractor shall not alone serve as the basis for a Claim for additional compensation or time. In the event there is interference with the Work, which is beyond its control, Contractor shall attempt to reschedule the Work in a manner that will hold resulting additional time and cost to a minimum. The construction schedule shall be in a detailed format satisfactory to the Owner and the Architect and shall also:

.1 Provide a graphic representation of all activities and events that will occur during performance of the Work;
.2 identify each phase of construction and occupancy; and
.3 set forth dates that are critical in ensuing the timely and orderly completion of the Work in accordance with the requirements of the Contract Documents hereinafter referred to as Milestone Dates.

Insert new paragraph 3.10.5 as follows:

3.10.5 The Owner shall have the right to reschedule the time of day for the performance of any part of the Work that may interfere with the operation of the Owner's premises or any tenants or invitees thereof. The Contractor shall, upon the Owner's request, reschedule any portion of the Work affecting operation of the premises during hours when the premises are not in operation. Any rescheduling of performance of the Work under this Subparagraph 3.10.5 may be grounds for an extension of the Contract Time, if permitted under Subparagraph 8.3.1 and an equitable adjustments in the Contract Sum, if: (1) the performance of the Work was properly scheduled by the Contractor in compliance with the requirements of the Contract Documents, (2) such rescheduling is required for the convenience of the Owner and is not attributable to any act or omission of Contractor, and (3) if Owner agrees to the Contract Sum adjustment prior to any rescheduling.

Insert New 3.10.6:

3.10.6 If the project is behind schedule, Contractor shall submit a "Recovery Plan" which will indicate the manner in which Contractor intends to get the Work back on schedule. Owner may require Contractor to take efforts to expedite progress of the Work in conformance with the progress anticipated by the schedule, which actions may include without limitations, increasing the number of workmen performing the Work, utilizing overtime work and requiring additional work shifts. In the event of such unexcused Project delays, any extra costs incurred by the Contractor to place the Project back on schedule shall be at Contractor's sole expense.

3.11 <u>Documents and Samples at the Site</u>

3.11 In line 2 after "selections" insert "(all changes and selections to be approved by Owner and Architect in advance)".

After 3.11 insert new 3.11.1 and 3.11.2 as follows:

3.11.1 At the Date of Substantial Completion and as a condition precedent to final payment, Contractor shall furnish the following documents to Architect for submittal to Owner: Record Drawings showing the field changes and selections (all changes and selections to be approved by Owner and Architect in advance) affecting the general

construction, mechanical, electrical, plumbing, and all other Work, and indicating the Work as actually installed. These shall consist of carefully drawn markings on a set of reproducible prints of Architect's Drawings obtained and paid for by Contractor. Contractor shall maintain at the job site one (1) set of Architect's Drawings and indicate thereon each field change as it occurs. The Contractor shall post all Addenda on Construction Documents prior to commencing work on the site.

3.11.2 Contractor shall at all times maintain job records, including, but not limited to, invoices, payment records, payroll records, daily reports, logs, diaries, and job meeting minutes, applicable to the project. Contractor shall make such reports and records available to inspection by the Owner, Architect, or their respective agents, within five (5) working days of request by Owner, Architect, or their respective agents.

3.12 Shop Drawings, Product Data and Samples

3.12.5 At the end of the paragraph insert the following, "If, in the opinion of the Architect, the Shop Drawings, Product Data, Samples and similar submittals are incomplete, indicate an inadequate understanding of the work covered by the submittals, or indicate a lack of study and review by the Contractor prior to submittal to the Architect, the submittals will be returned, unchecked, to the Contractor for correction of these three deficiencies and subsequent re-submittal. Additional service charges as outlined in 3.2.7 may be charged by the Architect in this event.

3.12.10 In line 9 after "design professional" insert "and who shall comply with requirements of Owner regarding qualifications and insurance and".

Insert new 3.12.11 and 3.12.12 as follows:

3.12.11 The Contractor shall submit Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents to the Architect at least 30 days prior to the date the Contractor needs the reviewed submittals returned. Where colors are to be selected by the Architect, the Contractor shall submit all Samples in adequate time to allow the Architect to prepare a complete selection schedule. In general, all submittals requiring color selection shall be submitted to the Architect within four weeks of the date of the Contract for construction.

3.12.12 The Contractor shall submit the number of copies of Shop Drawings, Product Data, Samples and similar submittals which the Contractor and his Subcontractors need for their use plus two additional sets for the Architect and one additional set for each of the Architect's consultants involved with the particular section of work. Where shop drawings are involved, the Contractor shall submit one high quality reproducible transparency and one opaque print of the shop drawing for the Architect plus one additional opaque print for each of the Architect's consultants involved with the particular section of work. The reproducible transparency will be marked by the Architect and/or his consultants and returned to the Contractor for his use, distribution,

correction or re-submittal as required. The Architect and his consultants will retain the marked up prints. After final review and correction of the submittal, the Contractor shall send two corrected sets to the Architect, and one to each of the Architect's consultants involved with the particular section of work.

3.13 Use of Site

Insert new 3.13.1, 3.13.2, 3.13.3 and 3.13.4 as follows:

3.13.1 Only materials and equipment which are to be used directly in the Work shall be brought to and stored on the Project site by the Contractor. After equipment is no longer required for the Work, it shall be promptly removed from the Project site but in no event shall the equipment be left on the Property longer than two (2) days after its completed use. Protection of construction materials and equipment stored at the Project site from weather, theft, damage and all other adversity is solely the responsibility of the Contractor.

3.13.2 The Contractor and any entity for whom the Contractor is responsible shall not erect any sign on the Project site without written consent of the Owner.

3.13.3 Contractor shall ensure that the Work, at all times, is performed in a manner that affords reasonable access, both vehicular and pedestrian, to the site of the Work and all adjacent areas. The Work shall be performed to the fullest extent reasonably possible, in such a manner that public areas adjacent to the site of the Work shall be free from all debris, building materials and equipment likely to cause hazardous conditions. Without limitation of any other provision on the Contract Documents, Contractor shall use its best efforts to minimize any interference with the occupancy or beneficial use of: (1) any area and buildings adjacent to the site or the Work or (2) the Building in the event of partial occupancy.

3.13.4 Without prior approval of the Owner, the Contractor shall not permit any workers to use any existing facilities at the Project site, including without limitation, lavatories, toilets, entrance and parking areas other than those designated by Owner. Without limitation of any other provisions of the Contract Documents, the Contractor shall use its best efforts to comply with all rules and regulations promulgated by the Owner in connection with the use and occupancy of the Project site and the Building, as amended from time to time.

3.15 Cleaning Up

Insert new 3.15.3 as follows:

3.15.3 Prior to the Architect's inspection for Submittal Completion the Contractor shall clean exterior and interior surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces; clean equipment and fixtures to a sanitary condition; replace air filters in mechanical equipment; clean roof,

gutters and downspouts; remove obstructions and flush debris from drainage systems; clean site; sweep paved areas and rake clean other surfaces; remove trash and surplus materials from the site.

Replace 3.18.1 with the following:

3.18.1 TO THE FULLEST EXTENT PERMITTED BY LAW, THE CONTRACTOR SHALL BE LIABLE FOR, INDEMNIFY, DEFEND AND HOLD HARMLESS THE OWNER, ARCHITECT, OWNER'S AND ARCHITECT'S CONSULTANTS, AND AGENTS, OFFICERS, AFFILIATES, AND EMPLOYEES OF ANY OF THEM (THE "INDEMNIFIED PARTIES") 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 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 WHICH WOULD OTHERWISE EXIST AS TO A PARTY OR PERSON DESCRIBED IN THIS SECTION 3.18.

CONTRACTOR EXPRESSLY ACKNOWLEDGES THAT IT IS INDEMNIFYING THE INDEMNIFIED PARTIES FROM THEIR CONCURRENT NEGLIGENCE BY THIS INDEMNITY. CONTRACTOR'S DEFENSE OBLIGATION HEREUNDER SHALL APPLY EVEN WHERE THE INDEMNIFIED PARTIES ARE ALLEGED TO BE SOLELY NEGLIGENT, BUT CONTRACTOR SHALL HAVE NO OBLIGATION TO INDEMNIFY THE INDEMNIFIED PARTIES WHERE A TRIER OF FACT DETERMINES THAT THE CLAIM WAS CAUSED BY THEIR SOLE NEGLIGENCE.

IN ADDITION TO THE ABOVE INDEMNITY, THE CONTRACTOR ACKNOWLEDGES THAT THE OWNER SHALL HAVE NO OBLIGATION TO SUPERVISE PERFORMANCE OF THE WORK OR WORK SITE FOR SAFETY. IF THE OWNER IS SUED BY (A) AN EMPLOYEE OF THE CONTRACTOR, (B) THE CONTRACTOR'S SUBCONTRACTOR (OF ANY TIER) OR ITS EMPLOYEES, OR (C) AN INSURANCE COMPANY OF EITHER FOR INJURY, DEATH, OR PROPERTY DAMAGE RESULTING FROM CONDUCT OF THE CONTRACTOR OR ITS SUBCONTRACTORS (OF ANY TIER) AND CLAIMS THAT THE OWNER WAS ALLEGEDLY NEGLIGENT IN NOT SUPERVISING THE WORK OR THE WORKSITE FOR SAFETY, THEN THE CONTRACTOR WILL INDEMNIFY AND DEFEND THE OWNER FROM ALLEGATIONS OF THE OWNER'S NEGLIGENCE, WHETHER ALLEGED TO BE CONCURRENT OR SOLE NEGLIGENCE, IN FAILING TO

SUPERVISE THE WORK OR SITE. CONTRACTOR EXPRESSLY ACKNOWLEDGES THAT IT IS INDEMNIFYING THE INDEMNIFIED PARTIES FOR THEIR SOLE NEGLIGENCE FOR ALLEGATIONS OF FAILURE TO SUPERVISE THE WORK OR THE WORK SITE.

THE FOREGOING INDEMNIFICATION OBLIGATION SHALL NOT BE LIMITED IN ANY WAY BY LIMITATION ON THE AMOUNT OR TYPE DAMAGES, COMPENSATION OR BENEFITS PAYABLE UNDER WORKERS' OR WORKMEN'S COMPENSATION ACTS, DISABILITY BENEFIT ACTS OR OTHER EMPLOYEE BENEFIT ACTS.

THE CONTRACTOR'S DEFENSE, INDEMNITY AND HOLD-HARMLESS OBLIGATIONS UNDER THIS CONTRACT SHALL SURVIVE COMPLETION OF THE WORK OR EARLY TERMINATION OF THE CONTRACT.

Insert new 3.19 as follows:

3.19 Substitutions of Products and Systems, "Or Equal" Brands

Insert new 3.19.1 and 3.19.2 as follows:

3.19.1 The materials, products and the systems 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 equivalent or better materials, products or systems provided that it meet the requirements of the particular project and have been approved in an addendum as a substitution prior to the submission of bids. If prior written approval in an addendum has not been obtained, it will be assumed that the Bid is based upon the materials, products, and systems described in the Bidding Documents and no substitutions will be permitted, except as provided hereinafter.

3.19.2 If, after award of contract, the Contractor or one of his Subcontractors or Suppliers determines that any of the products or systems specified will perform in a manner that will limit the Contractor's ability to satisfactorily perform the work or to honor the Warranty, the Contractor shall promptly, but no later than two days after such determination, notify the Architect, in writing, providing detailed substantiation for his position. Any changes deemed necessary by the Owner and Architect, including substitution of materials and change in Contract Sum, either upward or downward, if any, shall be accompanied by appropriate modification.

Insert new 3.20 as follows:

3.20 Record Drawings

Insert new 3.20.1 as follows:

3.20.1 At the completion of the project, the Contractor shall submit one complete set of blue lines showing all changes and routing of utilities made during construction, excluding Architect made CAD changes, to the Architect. Drafting shall be legible to the Architect's satisfaction. The Contractor shall pay for the cost of the required recording/drafting. The record set shall be kept up to date on a daily basis and the Architect shall review its status at the project meetings. The Architect shall furnish the Contractor with a blueline set at contract award which shall have all Addenda incorporated. The Owner will pay for the printing of the blueline set. The Architect will incorporate any record information into the construction (CAD) documents and provide the Owner with an electronic copy of the record information on the Construction documents that have all bid and construction changes incorporated. The cost for incorporating the record information into the CD will be paid for by the Owner. The Architect will transmit the electronic CD to the Owner with a copy of the transmittal to the Contractor's construction manager.

ARTICLE 4 – ARCHITECT

4.1 General

4.1.3 In line 1 delete "as to whom the Contractor has no reasonable objection and". In line 3 insert "former" before Architect.

4.2 Administration of the Contract

4.2.3 Delete the last two sentences in their entirety and insert "Architect shall not have control over or charge of and shall not be responsible for safety precautions and programs in connection with the Work. Architect shall be responsible for immediately notifying Contractor of the failure of Contractor, Subcontractors or any other persons performing any of the Work, in failing to use proper construction means, methods, techniques, sequences, procedures, safety precautions and programs, but only to the extent Architect becomes aware of, or should, exercising due professional diligence, be aware of, same. Architect shall also immediately notify Owner in writing of the failure of any of the foregoing parties to carry out the Work in accordance with the Contract Documents."

4.2.7 In line 1, after "approve" insert "or reject,". In line 2, delete "but only for the limited purpose of checking".

4.2.12 Delete the last sentence in this paragraph.

4.2.13 Delete paragraph in its entirety.

ARTICLE 5 – SUBCONTRACTORS

5.1 Definitions

5.1.1 In line 2, after "site" delete "." and insert "or to otherwise furnish labor, material, or other services with respect to a portion of the Work."

5.1.2 In line 2, after "site" delete "." and insert "or to otherwise furnish labor, material, or other services with respect to a portion of the Work."

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

5.2.1 In line 2 after "Contract," insert "but no later than 10 days prior to the submittal date for the Contractor's first Application for Payment,". At the end of the paragraph insert, "Failure of the Contractor to submit the subject names in a timely manner may delay processing of the Contractor's Application for Payment."

5.3 Subcontractual Relations

5.3 In line 1, after "appropriate" add "written" and delete "written where legally required for validity."

Insert new 5.3.1 as follows:

5.3.1 All subcontracts shall be in written form

5.4 Contingent Assignment of Subcontracts

Add at the end of 5.4.1

"Such assignment shall not constitute a waiver by Owner of its rights against Contractor because of defaults, delays and defects for which a Subcontractor or material vendor may also be liable. Contractor indemnifies and holds Owner harmless from any failure or refusal of any Subcontractor to comply with any provision of the Contract Documents. "

5.4.3 Delete the second sentence in its entirety.

Insert new paragraph 5.5 as follows:

5.5 Contractor shall immediately notify Owner and Architect of any material defaults by any Sub-contractor. Notwithstanding any provision contained in Article 5 to the contrary, it is hereby acknowledged and agreed that Owner has in no way agreed, expressly or implicitly, nor will Owner agree, to allow any Sub-contractor or other materialman or workman employed by Contractor the right to obtain a personal judgment or to create a lien against Owner for the amount due from the Contractor.

ARTICLE 6 – CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTOR

6.2 Mutual Responsibility

6.2.3 Delete in its entirety.

6.2.4 In line 1 delete "wrongfully".

ARTICLE 7 – CHANGES IN THE WORK

7.1 General

7.1.1 In line 2, before "be" add "only".

7.1.2 In Line 2, delete "and" after the word "Owner" and insert "and/or".

7.1.2 In line 3, insert the word "Owner or the Architect" before the words "issued by the", and delete "alone" and insert "subject to the approval of Owner".

7.1.3 At the end of the paragraph insert "Except as permitted in Paragraph 7.3 and 9.7, a change in the Contract Sum or the Contract Time shall be accomplished only by Change Order. Accordingly, no course of conduct or dealings between the parties, nor express or implied acceptance of alterations or additions to the Work and no claim that Owner has been unjustly enriched by any alteration of or addition to the Work, whether or not there is, in fact, any unjust enrichment to the Work, shall be the basis of any claim to an increase in any amounts due under the Contract Documents or a change in any time period provided for in the Contract Documents."

7.2 Change Orders

After 7.2.1 add new 7.2.2 and 7.2.3 as follows:

7.2.2 Agreement on any Change Order shall constitute a final settlement of all matters relating to the change in the Work that is the subject of the Change Order, including, but not limited, to all direct and indirect costs associated with such change and any and all adjustments to the Contract Sum and the construction schedule.

7.2.3 Contractor shall keep and periodically submit to Owner copies of a log for all Change Orders.

7.2.4 Changes in the Work: The Owner, without invalidating the Contract and without approval of the surety, may order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions. The Contractor may recommend and propose changes in the Work to be considered by the Owner. The Contract Sum and the Contract Time will only be adjusted in accordance by Change Orders processed and approved by the Owner.

7.2.4.1 No written order or oral order from the Owner (which terms as used in this paragraph shall include direction, instruction, interpretation, or determination) which fails to address Contract Time or Contract Sum shall be treated as a change in the Contract which affects the Contract Time or the Contract Sum unless the Contractor gives the Owner written notice within ten (10) days of such written or oral order stating the date, circumstances, source of the order and that the Contractor regards the order to be a change in the Contract which affects the Contract Time or the Contract Sum. Except as provided above, no order, oral statement, or direction of the Owner shall be treated as a change in the Work to be addressed by a Change Order or entitle the Contractor to an adjustment in the Contract Time or the Contract Sum.

7.2.5 Change Proposals: The Contractor shall review and respond to all requests for a Change Proposal submitted by the Architect in accordance with the following:

7.2.5.1 In responding to a request for a Change Proposal, the Contractor shall furnish a lump sum proposal supported by a complete breakdown as described hereafter and satisfactory to the Owner indicating the total estimated cost for performance of the changed Work including the applicable percentage for overhead and profit. To permit evaluation by the Owner, any request for a time extension must be justified and presented in adequate detail, showing that the proposed change will cause a delay in meeting one or more Milestones. The contractor shall make all reasonable efforts to rearrange the work to avoid time extensions. Any extension that may be approved shall be net of any delays caused by or due to the fault or negligence of the Contractor or which are otherwise the responsibility of the Contractor and shall be also net of any contingency or "float" time in the Project Schedules.

7.2.5.1.1 The Contractor 's cost proposal given in response to a request for a Change Proposal shall, unless otherwise consented to in writing by the Owner, contain the following items for changed Work performed directly by the Contractor or performed by a Subcontractor:

a) Estimated cost, using any discounts to the trades, of the materials and supplies used, which shall be itemized completely to include unit cost, quantity and total cost.

b) Estimated wages paid for labor performing the additional Work, which shall be itemized completely to include for each trade and skill level the hourly rate, total hours and total cost. Such wages shall include labor required for performance of the changed Work only. Crew foremen may be included. All other supervisors shall be excluded and shall be considered as a part of the Overhead Markup.

c) Estimated cost for construction equipment used on the changed Work, to include rental rates or owned equipment rates for such items of equipment while in use directly on the changed Work covered by the Change

Proposal, which shall be itemized completely to include type(s), the number(s) of each, hourly rate, hours, total cost and state sales tax paid. Rental or owned equipment rates shall be no greater than those established by market conditions for the local area. As used herein the terms "construction equipment" and "equipment" shall include wheeled vehicles and tools. The Owner retains the right of purchase or lease purchase if cumulative rental costs make this an economically sound option.

d) Estimated reasonable transportation costs for delivery and handling of materials, additional construction equipment, and/or new items of installed equipment, if applicable, which shall be itemized separately.

e) Estimated off-site storage costs for periods in excess of thirty (30) calendar days, if applicable, covering protection of new items or equipment to be installed.

f) A percentage for labor burdens added to the wages computed in accordance with (b) above. Such percentage for labor burden shall be delivered in writing by the Contractor to the Owner for approval by the Owner within ten (10) days after issuance of the Notice to Proceed. This percentage shall reimburse the Contractor for the actual cost of FICA, State and Federal Unemployment Insurance, insurance computed on wages, small tools (tools having an original value of $500 or less, consumable supplies, and training and fringe benefits, if applicable. The premium portion of any overtime (which must be approved in advance by the Owner in writing) shall not include an allowance for small tools (toolshaving an original value of $500 or less), consumable supplies, training or fringe benefits.

7.2.5.1.2 In submitting the response to a Change Order Proposal, a mark-up of ten percent (10%) of the items in (a)-(f) above may be included for the Contractor or Subcontractor directly performing the changed Work covered by items (a)-(f) above. Such ten percent (10%) mark-up is intended to cover all field supervision above the level of crew foreman, field and general home office services and expenses, interference with other work or any other consequential effects, adjustments to progress schedules and all other overhead (including bond and insurance not computed on wages) and profit of the Contractor or Subcontractor directly performing the changed Work.

7.2.5.1.3 In submitting the response to a Change Order Proposal, a mark-up of five percent (5%) of any payments to a Subcontractor may be included for the Contractor and any Subcontractors which supervise the Subcontractor directly performing the changed Work. Such five percent (5%) mark-up is intended to fully reimburse the Contractor and any Subcontractor supervising the Subcontractor directly performing the changed Work for overhead expenses and profit.

7.2.5.1.4 In cases where changes in the Work performed by the Contractor with its own forces or by a Subcontractor result in a credit (i.e., cost savings) to the Owner, the credit shall be limited to direct costs to the Contractor or Subcontractor, which include the labor burden described in paragraph 7.3.1.1(f) above; that is, no overhead or profit shall be credited. In cases where an individual change in the Work results in both credits and charges to the Owner, the Contractor will add the overhead and profit percentages indicated in this Section above only to the "net" charge to the Owner (i.e., based upon the amount by which the total charges exceed the total credits to the Owner).

7.2.5.2 The Contractor 's response to a request for a Change Proposal shall be submitted in writing within ten (10) days after the Owner's delivery to the Contractor of the Change Proposal request, unless the Owner extends such period of time in writing. Changes in the Contract Time and/or Contract Sum will be negotiated as soon as practicable thereafter. If agreement is reached, the agreed changes will be incorporated in a Change Order and such Change Order shall be signed by the Contractor and the Owner. If (i) the Contractor fails to timely respond to a request for a Change Proposal, (ii) the Owner and the Contractor do not agree as to changes in the Contract Time or Contract Sum, or (iii) the Owner concludes that the time needed for obtaining a proposal from the Contractor and negotiating a Change Order would significantly damage the Project and/or impose significant added cost, the Owner may, at its option, issue a Unilateral Change Order without the agreement of the Contractor as to changes in the Contract Time and Contract Sum. In all events, the Contractor will diligently proceed to accomplish the Work set forth in the Change Order issued by the Owner. Contractor shall not be required to perform or subcontract work for removal, remediation, and/or transportation of hazardous materials.

7.3 Construction Change Orders

7.3.1 At the end of the paragraph insert "Contractor shall keep and periodically submit to Owner copies of a log for all Construction Change Directives and a log for all requests for information."

7.4 Minor Changes in the Work

7.4 In line 1 after "authority" add "after having obtained Owner's approval".

ARTICLE 8 – TIME

8.1 Definitions

After 8.1.1 insert the following new paragraphs:

8.1.1.1 The Work shall be fully completed within the time limit and/or date stated in the Contract between Owner and Contractor.

8.1.1.2 Liquidated Damages: If the Contractor should fail to fully complete the Work within the stated time (subject however to extension of time duly granted in the manner and for the causes specified in the General Conditions), Contractor shall be charged by and shall pay to Owner, as liquidated damages, the sum specified in Article 3.1 of the Modified AIA document A101 – 2007 Edition per calendar day that the Work remains incomplete beyond the time fixed for completion. Contractor hereby agrees that from the nature of the project it would be impracticable and extremely difficult to fix the actual damage that would or will be suffered in the event that Contractor should fail to fully complete the Work by the time limit or date stated and the amount of the liquidated damages are fair and reasonable. The parties agree that the liquidated damages are a reasonable forecast of just compensation for the harm done to Owner that would be caused by Contractor's failure to timely complete the Work and are not a penalty. Contractor agrees that the amount of liquidated damages due Owner may be deducted by Owner from any monies that might otherwise be or become payable to Contractor.

8.3 Delays and Extensions of Time

8.3.1 In line 4 delete "and arbitration". At the end of the paragraph delete "." , and insert ", provided, however, that such extension of Contract Time shall be net of any delays caused by or due to the fault or negligence of Contractor or that are otherwise the responsibility of Contractor and shall also be net of any contingency or float time allowance included in Contractor's construction schedule. Contractor shall, in the event of any occurrence likely to cause a delay, cooperate in good faith with Architect and Owner to minimize and mitigate the impact of any such occurrence and do all things reasonable under the circumstances to achieve this goal."

Delete existing Article 8.3.3 and replace with the following:

Extension of time shall be Contractor's sole remedy for any such delay, unless the same shall have been caused by acts constituting intentional interference by Owner with Contractor's performance of the Work and where and to the extent that such acts continue after Contractor's notice to Owner of such interference. Owner's exercise of any of its rights under this Agreement, or Owner's exercise of any of its remedies of suspension of the Work, or requirement of correction or re-execution of any defective Work, shall not under any circumstances be construed as intentional interference with Contractor's performance of the Work.

ARTICLE 9 – PAYMENTS AND COMPLETION

9.2 Schedule of Values

9.2 In line 1 after "submit to the" insert "Owner and". In line 3 delete "and prepared in such from and supported by such data to substantiate its accuracy as the Architect may require" and insert, "which in the aggregate equals the total Contract Sum, divided so as

to facilitate payments to Subcontractors, supported by such evidence of correctness as Architect may direct or as required by Owner. This schedule, when approved by Architect and Owner, shall be used to monitor the progress of the Work and as a basis for Certificates for Payment. All items with entered values will be transferred by Contractor to the "Application and Certificate for Payment, and shall include the latest approved Change Orders and Construction Change Directives. Change Order values and Construction Change Directives values shall be broken down to show the various subcontracts. The Application for Payment shall be on a form as provided by Architect and approved by Owner. Each item shall show its total scheduled value, value of previous applications, value of the application, percentage completed, value completed, and value yet to be completed. All blanks and columns must be filled in, including every percentage complete figure."

9.3 Applications for Payment

9.3.1 In line 2 delete "if required under Section 9.2" At the end of the paragraph insert "Any allowances included in the Application for Payment shall be separately itemized with supporting data attached. The Application for Payment shall be accompanied by a certification by an officer of the Contractor to the effect that:

> There are no known mechanics', materialman's or laborers' liens or claims, or any other liens or claims, legal or equitable, contractual, statutory, or constitutional, outstanding or known to exist at the date of this Application; all due and payable bills with respect to the Work have been paid to date or are included in the amount requested in the current Application and there is no known basis for the filing of any mechanics', materialman's or laborers' lien or claim, or any other lien or claim, legal or equitable, contractual, statutory, or constitutional, on the Work; and waivers and releases from all Subcontractors, laborers, and material men for Work done and materials furnished have been obtained in such form as to constitute an effective waiver and release of all such liens and claims under the laws of the state within which the Project is located and shall be delivered to Architect together with Contractor's waiver and release of liens and claims at the time of submission of the Application for Payment.

Certifications shall also be submitted by all subcontractors and suppliers with each application for payment for Work performed the given payment period. "

9.3.2 In line 4 after "in writing" insert "by the Owner and Surety." At the end of the paragraph insert the following, "Under no circumstances will the Owner reimburse the Contractor for down payments, deposits, or other advance payments for materials or equipment."

9.3.3 At the end of the paragraph insert, "The vesting of such title shall not impose any obligations on Owner or relieve Contractor of any of its obligations under the Contract, that Contractor shall remain responsible for damage to or loss of the Work, whether

completed or under construction, until responsibility for the Work has been accepted by Owner in the manner set forth in the Contract Documents.

9.4 Certificates for Payment

9.4.2 In line 2, after "and" add "on all other information available to Architect including, without limitation,". In line 8, after "certified", delete "." and add "and that the aggregate amount theretofore paid to Contractor plus any applicable retention does not exceed the value of the completed portion of the Work. In line 11, delete "reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by Owner to substantiate Contractor's right to payment, or (4)".

9.5 Decisions to Withhold Certification

9.5.1.3 Add to the end of the sentence, "and failure to provide certifications of payment by the Contractor and its subcontractors and suppliers."

9.5.1.6 In line 1 delete "and" and insert "or".

9.5.1.7 In line 1 delete "repeated".

After 9.5.3 insert new 9.5.4 as follows:

9.5.4 Notwithstanding any provision contained within this Article, if the Work has not attained Substantial Completion with the contract time, subject to extensions of time allowed under these Conditions, Architect may withhold any further payment to Contractor to the extent necessary to preserve sufficient funds to complete the construction of the Project and to cover liquidated damages assessed against Contractor up to the time of the Application for Payment and to the time it is reasonably anticipated that Substantial Completion will be achieved.

9.6 Progress Payments

9.6.1 At the end of the paragraph insert the following, "Owner may refuse to make payment on any Certificate for Payment for any default of the Contract, including, but not limited to, those defaults set forth in Clauses 9.5.1.1 through 9.5.1.7. Owner shall not be deemed in default by reason of withholding payment while any of such defaults remain uncured."

9.6.4 In line 5 delete "except as may otherwise be required by law."

9.6.7 Delete in its entirety.

9.7 Failure of Payment

9.7 In line 2, after "not" add ", for reasons other than a default of the Contract,

including, but not limited to, those defaults set forth in Clauses 9.5.1.1 through 9.5.1.7". In line 3 delete "or awarded by binding dispute resolution".

Insert new 9.7.1 as follows:

9.7.1 If Owner is entitled to reimbursement or payment from Contractor under or pursuant to the Contract Documents, such payment shall be made promptly upon demand by Owner. Notwithstanding anything contained in the Contract Documents to the contrary, if Contractor fails to promptly make any payment due Owner, or if Owner incurs any costs and expenses to cure any default of Contractor or to correct defective Work, Owner shall have an absolute right to offset such amount against the Contract Sum and may, in Owner's sole discretion, elect either to (i) deduct an amount equal to that which Owner is entitled from any payment then or thereafter due Contractor from Owner, or (ii) issue a written notice to Contractor reducing the Contract Sum by an amount equal to that which Owner is entitled.

9.8 Substantial Completion

9.8.1 In line 1 after "thereof" add "(which Owner agrees to accept separately)".

9.8.4 In line 5, delete "Substantial Completion of the Work or designated portion thereof" and substitute "issuance of the certificate of final payment by Architect". At the end of the paragraph insert "The Work will not be considered suitable for Substantial Completion review until all Project systems included in the Work are operational as designed and scheduled, all designated or required governmental inspections and certifications have been made and posted, designated instruction of Owner's personnel in the operation of systems has been completed, and all final finishes within the Contract are in place. In general, the only remaining Work shall be minor in nature, so that Owner and/or Owner's employees and if applicable, the public, could occupy the building on that date and the completing of the Work by Contractor would not materially interfere or hamper Owner's or Owner's employees and if applicable, the public, (or those claiming by, through, or under Owner) normal school operations. As a further condition of Substantial Completion acceptance, Contractor shall certify that all remaining Work will be completed within thirty (30) consecutive calendar days or as agreed upon following the Date of Substantial Completion. If Contractor requests a Substantial Completion review, and Architect, after performing the Substantial Completion review, finds that the Project was not ready for the Substantial Completion review, then Contractor shall pay the Architect's fees for any additional Substantial Completion reviews."

After 9.8.5 insert new 9.8.6 and 9.8.7 as follows:

9.8.6 In order for the project or a major portion thereof to be considered substantially complete, the following conditions must be met: (1) All inspections by governmental authorities have jurisdiction over the project must have been finalized, any remedial work required by those authorities must have been completed, and Certificates of

Occupancy and similar governmental approval forms must have been issued and copies delivered to the Owner and Architect. (2) All work, both interior and exterior, shall have been completed and cleaned except minor items which if completed after occupancy, will not, in the Owner's opinion, cause interference to the Owner's use of the building or any portion thereof. A significantly large number of items to be completed or corrected will preclude the Architect from issuing a Certificate of Substantial Completion. The Owner and Architect will be the sole judge of what constitutes a significantly large number of items.

9.8.7 After the date of Substantial Completion of the Project is evidenced by the Certificate of Substantial Completion, the Contractor will be allowed a period of thirty (30) days, unless extended by mutual agreement or provision of the Contract, within which to correct all deficiencies attached to the Certificate of Substantial Completion. Failure of the Contractor to complete such corrections within the stipulated time will be reported to the Contractor's surety. In this report, the Contactor and surety will be informed that, should correction remain incomplete for fifteen (15) days, the Owner may initiate action to complete corrective work out of the remaining Contract funds in accordance with Article 14.

9.10 Final Completion and Final Payment

9.10.2 Add at the end of the first grammatical sentence "(6) Record Drawings, and (7) Maintenance and instruction Manuals, three sets bound in a 3" ring binder."

9.10.4 In line 2, clause .2, delete "or"; In line 2, clause .3, delete "." and substitute "; or"; and add at the end " .4 faulty or defective Work appearing after Substantial Completion."

ARTICLE 10 – SAFETY OF PERSONS AND PROPERTY

10.2 Safety of Persons and Property

10.2.3 At the end of the paragraph insert "The Contractor shall also be responsible, at the Contractor's sole cost and expense, for all measures necessary to protect any property adjacent to the project and improvements therein. Any damage to such property or improvements shall be immediately repaired by the Contractor."

10.3 Hazardous Materials

10.3.3 Delete paragraph in its entirety.

10.3.4 Delete second sentence in its entirety.

10.3.6 Delete paragraph in its entirety.

Add the following at the end of 10.4

"; provided the Contractor shall not be entitled to additional compensation or an extension of time if an emergency is caused by the negligence or failure to fulfill a specific responsibility of the Contractor to the Owner set forth in the Contract Documents or the failure of the Contractor's personnel to supervise adequately the Work of the Subcontractors or suppliers."

ARTICLE 11 – INSURANCE AND BONDS

11.1 Contractor's Liability Insurance

11.1.1 In line 2 after "Contractor" insert "and Owner".

After 11.1.4 add the following new 11.1.5, 11.1.6 and 11.1.7 as follows:

11.1.5 SCHEDULE OF INSURANCE COVERAGES

11.1.5.1 Contractor shall carry and keep in full force for the duration of the project the following Coverage.

Coverage	Amounts and Limits
Worker's Compensation	Statutory Limits
Employer's Liability:	
Bodily Injury by Accident	$1,000,000/each accident
Bodily Injury by Disease	$1,000,000/each employee
Bodily Injury by Disease	$1,000,000/Policy Limit
Commercial General Liability	
Bodily Injury/Property Damage	$1,000,000.00 per occurrence $2,000,000.00 aggregate

(Premises Operations, Independent Contractors, Product/Completed Operations, Personal Injury, Contractual Liability, Explosion, Collapse, Underground and Broad Form Property Damage).

Comprehensive Automobile Liability	$1,000,000.00 Combined Single Limit per Occurrence

Auto liability insurance shall be on a standard form written to cover all owned, hired, and non-owned automobiles. The policy shall be endorsed to include the Indemnified Parties (paragraph 3.18) as additional insured, contain cross-liability and severability of interest endorsements, and state that this insurance is primary insurance as regards to any other insurance carried by the Indemnified Parties (see paragraph 3.18).

11.1.5.2 All policies shall contain special endorsements to include:

.1 The Owner as an additional insured (except for Worker's Compensation) and all other parties identified in 3.18 (Indemnified Parties);

.2 Wavier of Subrogation in favor of Owner under the Worker's Compensation and Employer's Liability policies.

.3. A statement that a notice shall be given to Owner by certified mail fifteen (15) days prior to cancellation or upon any material changes in coverage.

4. Contain cross-liability and severability of interest endorsements;

5. state that this insurance is primary insurance in regard to any other insurance carried by the indemnified Party (see 3.18));

.6 the following coverage:

a. Premises/Operations;
b. Independent Contractors;
c. Completed Operations following the acceptance of Contractor's Work;
d. Comprehensive General Liability Endorsement to include Blanket Contractual Liability (specifically covering, but not limited to, the contractual obligations assumed by Contractor, Broad Form Property Damage, and Personal Injury Liability with employee and contractual exclusions removed);
e. Deletion of exclusions relative to Collapse, Explosion, and Underground Property Damage Hazards;
f. Personal Injury Liability with the contractual exclusions removed;
g. Cross Liability Endorsement.

11.1.5.6 <u>Umbrella Excess Liability Insurance</u>

Bodily Injury and	$5,000,000 per occurrence
Property Damage	$5,000,000 aggregate

This policy shall be written on an umbrella excess basis above, the coverage described in this Article 11. The policy shall be endorsed to include the Indemnified Parties (3.18) as additional insureds. The policy shall contain cross-liability and severability of interest endorsements and shall state, as regard the Indemnified Parties that the insurance is primary insurance as to any other insurance carried by any Indemnified Party. The policy shall be endorsed to provide the defense coverage obligation. Insurance carried by the Contractor shall be with insurers having Best's Rating of A-V or better.

11.1.6 Further, Contractor shall require all Subcontractors to carry similar insurance coverage and limits of liability as required under this Article 11, adjusted to the nature of Subcontractor's operations and submit same to Owner for approval before any Work

commences.

11.1.7 In the event Contractor fails to obtain the required certificated of insurance from the Subcontractor and a claim is made or suffered, Contractor shall indemnify, defend, and hold harmless the indemnified parties from any and all claims for which the required insurance would have provided coverage.

11.2 Owner's Liability Insurance

After 11.2 insert the following new paragraphs:

11.2.1 By signing the Contract or providing or causing to be provided a Certificate of Coverage, the Contractor is representing to the Owner that all employees of the Contractor who will provide services on the Project will be covered by workers' compensation coverage for the duration of the Project, that coverage will be based on proper reporting or classification codes and payroll amounts, and that all coverage agreements will be filed with the appropriate insurance carrier or, in the case of a self-insured, with the commission's Division of Self-Insurance Regulation. Providing false or misleading information may subject the Contractor to administrative penalties, criminal penalties, civil penalties, or other civil actions.

11.2.2 Optionally, the Owner may require the Contractor to purchase and maintain Project Management Protective Liability insurance from the Contractor's usual sources as primary coverage for the Owner's, Contractor's and Architect's vicarious liability for construction operations under the contract. Unless otherwise required by the Contract Documents, the Owner shall reimburse the Contractor by increasing the Contract Sum to pay the cost of purchasing and maintaining such optional insurance coverage and the Contractor shall not be responsible for purchasing any other liability insurance on behalf of the Owner. The minimum limits of liability purchased with such coverage shall be equal to the aggregate of the limits required for Contractor's Liability Insurance under Article 11.

11.3 Property Insurance

11.3.1 IDEA Public Schools shall obtain and furnish Builders' Risk insurance for this project. The Contractor is responsible for the deductible, which shall not exceed $5,000.00 per claim for this project.

Insert new 11.3.1.1.1, 11.3.1.1.2 and 11.3.1.1.3 as follows:

11.3.1.1.1 For any claim made against Contractor's Builder's Risk Insurance, the deductible shall not exceed $2,500.00 for a Contract Sum of less than $4 million. For a Contract Sum of $4 million or more, the deductible shall not exceed $5,000.00.

11.3.1.1.2 The Contract waives all rights against (1) Owner, the Subcontractors, Sub-contractors, agents, and employees, and (2) the Architect, Architect's consultants, separate contractors, if any, and any of their Subcontractors, Sub-subcontractors, agents, and employees, for damages caused by fire or other perils to the extent covered by property insurance obtained pursuant to this paragraph or other property insurance applicable to the Work, except such rights as Contractor ahs to proceeds of such insurance held by the Contractor as a fiduciary. The Contractor, as appropriate, shall require of any separate contractors, Subcontractors, Sub-subcontractors, agents, and employees of any of them by appropriate written agreements, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had a insurable interest in the property damaged.

11.3.1.1.3 The Contractor as fiduciary shall have power to adjust and settle a less with insurers. The Contractor shall pay all Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements shall require Subcontractors to make payment to their Sub-subcontractors in similar manner. If required in writing by a party in interest, the Contractor as fiduciary shall, upon occurrence of insured loss, give bond for proper performance of the Contractor's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Contractor shall deposit in a separate account proceeds so received, which the Contractor shall distribute in accordance with such agreement as the parties in interest may reach. If after such loss no other special agreement is made and unless the Owner terminated the Contract for convenience, replacement of damaged property shall be performed by the Contractor under the insurance proceeds.

11.3.1.2 Delete paragraph n its entirety.

11.3.1.3 Delete paragraph in its entirety.

11.3.1.5 Delete 11.3.1.5 in its entirety and replace with the following, "Partial occupancy or use shall not affect the validity or coverage of property insurance."

11.3.2 The Contractor shall be responsible for obtaining an Installation Floater Insurance Policy for any protections desired beyond the policy limits provided by the Owner's Builder's Risk Policy.

11.3.3. <u>Loss of Use Insurance</u> -- Delete in its entirety.

11.3.5 Delete in its entirety.

11.3.6 Delete in its entirety.

11.3.7 **Waivers of Subrogation** -- Delete paragraph in its entirety and substitute the following, "The Contractor waives all rights against (1) Owner, the Subcontractors, Sub-subcontractors, agents, and employees, and (2) the Architect, Architect's consultants, separate contractors, if any, and any of their Subcontractors, Sub-subcontractors, agents, and employees, for damages caused by fire or other perils to the extent covered by property insurance obtained pursuant to Article 11 or other property insurance applicable to the Work, except such rights as Contractor has to proceeds of such insurance held by the Contractor as a fiduciary. The Contractor, as appropriate, shall require of any separate contractors, Subcontractors, Sub-subcontractors, agents, and employees of any of them by appropriate written agreements, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had a insurable interest in the property damaged."

11.3.9 Delete paragraph in its entirety.

11.3.10 In line 1 after "with insurers" delete the remainder of the grammatical sentence and the remaining paragraph and insert a ".".

11.4 Performance Bond and Payment Bond

11.4.1 Delete in its entirety and substitute the following, "The Contractor shall furnish a Performance Bond in an amount equal to one hundred percent (100%) of the Contract Sum, as security for the faithful performance of the Contract and also a one hundred percent (100%) Payment Bond, as security for the payment of all persons performing labor on the Project under this Contract and furnishing materials in connection with the Contract. The Performance Bond and the Payment Bond may be in one or in separate instruments in accordance with local law. Surety companies must be authorized to write surety bonds in Texas and any such surety bond must comply with the requirements of Subchapter A of 3503 of the Texas Insurance Code."

After 11.4.1 insert the following new 11.4.1.1 and 11.4.1.2 as follows:

11.4.1.1 The Contractor shall deliver the required Bonds to the Owner not later than the date of the preconstruction meeting. All Bonds will be reviewed by the Architect for compliance with the Contract Documents prior to the execution of the Contract. In the event that Architect has any questions concerning the sufficiency of the bonds, Architect shall refer the bonds to Owner or Owner's representative for decision.

11.4.1.2 All bonds shall be originals. The Contractor shall require the attorney-in-fact who executes the required Bonds on behalf of the Surety to affix thereto a certified and current copy of the power-of-attorney. The name, address, and telephone number of a contact person for the Bonding Company shall be provided.

After 11.4.2 insert the following new 11.4.3 as follows:

11.4.3 The Bonds shall be provided to comply with the terms and provisions of Chapter 2253 of the Texas Government Code. Bonds shall be signed by an agent resident in the State of Texas and date of bond shall be on or after the date of execution of the Contract but prior to the date of the notice to proceed. If at any time during the continuance of the Contract, the surety of the Contractor's bonds becomes insufficient, the Owner shall have the right to require additional and sufficient sureties which the Contractor shall furnish to the satisfaction of the Owner within ten (10) days after notice to do so. In default thereof, the Contractor may be suspended, and all payment or money due to the Contractor withheld until sufficient bonds are provided by Contractor.

ARTICLE 12 – UNCOVERING AND CORRECTION OF WORK

12.1 Uncovering of Work

12.1.1 At the end of the paragraph delete "," and insert "or Contract Sum."

12.2 Correction of the Work

12.2.1 Before or After Substantial Completion

12.2.1 In line 1 after ""by the Architect" insert "as incomplete, defective,".

12.2.2.1 In line 2, after "of the" add "entire"; after "Work" delete "or designated portion thereof or after the date for commencement of warranties established under Subparagraph 9.9.1," and substitute "(unless otherwise provided in any Certificate of Partial Substantial Completion approved by the parties), or within such longer period of time as may be prescribed by law or in equity,". In line 4, after "to be" add "defective or otherwise". In line 6, after "condition." delete the next two grammatical sentences and substitute the following: "This corrective period 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 performance of the Work. Corrective Work shall be warranted to be free from defects for a period equal to the longer of six (6) months after the completion of the corrective Work or one (1) year after the Date of Substantial completion (subject to extension as previously described) or such longer period of time as may be prescribed by law or in equity, or expiration of the term of any applicable special warranty, if applicable, required by the Contract Documents. Any defect in such Work shall be corrected again by Contractor promptly upon notice of the defect from Owner. This obligation under this Subparagraph 12.2.2.1 shall survive

acceptance of the Work under the Contract and termination of the Contract by the Owner."

After 12.2.2.3 add new paragraph 12.2.2.4 as follows:

12.2.2.4 Just before the termination of the various guarantee periods, Contractor shall accompany Owner's agent and Architect on an inspection tour of the building and shall note any defects and shall start remedying these defects within ten (10) days of the inspection tour and shall prosecute the Work without interruption until accepted by Owner and Architect, even though such prosecution should extend beyond the limit of the guarantee period.

12.2.4 In line 2, after "caused" add "in whole or in part". In line 3, after "that is" add Adefective or otherwise".

12.2.5 In line 2, after "Documents" delete "." and insert "or under law or in equity." In line 2 delete "one year".

12.3 Acceptance of Nonconforming Work

12.3.1 In line 1, after "is" insert "defective or otherwise".

ARTICLE 13 – MISCELLANEOUS PROVISIONS

13.1 Governing Law

In line 1 delete "except that, if the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4." and insert a "." at the end of the sentence.

13.3 Written Notice

13.3.1 At the end of the paragraph delete "." and insert "or if delivered by facsimile to the offices of the person or corporation for which it was intended. Facsimiles received after 5:00 p.m. on a business day, or on a weekend or legal holiday on which the recipient's offices are closed, notice shall be deemed to have been duly served on the next business day."

13.4 Rights and Remedies

13.4.1 At the end of the paragraph delete "." and insert "or in equity or by any other agreement, and any such rights and remedies shall survive the acceptance of the Work and/or any termination of the Contract Documents."

13.5 Tests and Inspections

13.5.1 Delete the last grammatical sentence in its entirety and insert the following, "Architect, Owner and Contractor shall be afforded a reasonable opportunity to attend, observe, and witness all inspections and tests of the Work. Architect or Owner may at any time request and receive from Contractor satisfactory evidence that materials, supplies, or equipment are in conformance with the Contract Documents. The conduct of any inspection or test and the receipt of any approval shall not operate to relieve Contractor from its obligations under the Contract Documents unless specifically so stated by Owner in writing."

13.5.2 Delete the last grammatical sentence in its entirety.

13.5.3 In line 2, after "Documents," delete the remainder of the subparagraph and substitute the following: "or reveal faulty or otherwise defective Work, or if the necessity of any such testing, inspection, or approval procedure arises out of the fault, neglect, or omission of Contractor, Contractor shall bear all costs of such testing, inspection, and approval procedures and all other costs made necessary by Contractor's failures, including, without limitation, those costs of repeated and additional procedures and compensation for Architect's services and expenses of Owner's personnel and consultant fees and expenses. Such costs shall be paid by Contractor within ten (10) days of receipt of invoice from Owner with supporting data attached."

13.5.4 In line 1 delete, "unless otherwise required by the Contract Documents,". In Line 2 delete, "promptly delivered to the Architect" and insert, "delivered to Owner, unless such testing or inspection services are arranged by Owner."

13.6 Interest

Delete paragraph in its entirety and replaced with the following, "An overdue payment bears interest at the rate of one half percent (.5%) each month, or at the legal rate established by the Texas Government Code, currently in Section 2251.025. Any such payment for any undisputed amounts shall be deemed overdue on the thirty-first (31st) day after Owner receives an acceptable invoice from Contractor."

13.7 Time Limits on Claims

In line 2 delete "in accordance with the requirements of the final dispute resolution method selected in the Agreement". In line 3 delete "," after "applicable law and insert "." In line 4 delete "but in any case more than 10 years after the date of Substantial Completion of the Work. Delete last grammatical sentence in its entirety.

Insert new Article 13.8 as follows:

13.8 Equal Opportunity

13.8.1 The Contractor shall maintain policies of employment as follows: "The Contractor and the Contractor's Subcontractors shall not discriminate against any

employee or applicant for employment because of race, religion, color, sex, or national origin. Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, religion, color, sex, or national origin. Such action shall include, but not be limited to, the following: employment, promotion, demotion, or transfer; recruitment, or recruitment advertising; lay-off or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants, notices setting forth the nondiscrimination policies."

13.8.1.1 The Contractor and the Contractor 's Subcontractors shall, in all solicitations or advertisements for employees placed by them or on their behalf; state that all qualified applicants will receive consideration for employment with regard to race, religion, color, sex, or national origin.

Insert new 13.9 as follows:

13.9 Certification of Asbestos-Free Project

13.9.1 Contractor shall submit to the Architect a letter addressed to the Owner certifying that all materials used in the construction of this Project contain less than 0.10 by weight of asbestos and for which it can be demonstrated that, under reasonably foreseeable job site conditions, will not release asbestos fibers in excess of 0.1 fibers per cubic centimeter. Certification letters shall be dated, shall reference this specific Project, and shall be signed by not less than two (2) officers of the construction company.

13.9.2 Certification shall further state that should asbestos fibers be found at this Project in concentrations greater than 0.1 fibers per cubic centimeter, that Contractor shall be responsible for determining which materials contain asbestos fibers and shall take corrective action to remove those materials from the Project at no additional cost to the Owner.

13.9.3 Final payment shall not be made until this letter of certification has been received.

ARTICLE 14 – TERMINATION OF SUSPENSION OF THE CONTRACT

14.1 Termination by the Contractor

14.1.1.3 Delete paragraph in its entirety.

14.1.1.4 Delete paragraph in its entirety.

14.1.3 In line 2 after "Work" insert "properly". In line 3 after "executed" insert, "in accordance with the Contract Documents." In line 3 delete "including reasonable overhead and profit, costs incurred by reason of such termination, and damages."

14.1.4 Delete paragraph in its entirety and insert the following in lieu thereof, "Owner shall not be responsible for damages for loss of anticipated profits on Work not performed on account of any termination described in Subparagraphs 14.1.1 and 14.1.2."

14.2 Termination by the Owner for Cause

14.2.1.1 Delete "repeatedly" and insert "and equipment" after "materials."

14.2.1.3 Delete "repeatedly" and delete "or" at the end of the paragraph.

14.2.1.4 Delete subparagraph in its entirety and replace with the following, "disregards the instructions of Architect or Owner (when such instructions are based on the requirements of the Contract Documents); or"

After 14.2.1.4 add new "14.2.1.5 and 14.2.1.6 as follows:

14.2.1.5 "is adjudged a bankrupt or insolvent, or makes a general assignment for the benefit of Contractor's creditors, or a trustee or receiver is appointed for Contractor or for any of its property, or files a petition to take advantage of any debtor's act, or to reorganize under bankruptcy or similar laws; or

14.2.1.6 "otherwise does not fully comply with the Contract Documents."

14.2.2 In line 1, after "Owner" delete ", upon certification by the Initial Decision Maker that sufficient cause exists to justify such action".

14.2.4 Delete paragraph in its entirety and replace with the following, "To the extent the costs of completing Work, including compensation for additional professional services and expenses, exceed those costs that would have been payable to Contractor to complete the Work except for Contractor's default, Contractor will pay the difference to Owner, and this obligation for payment shall survive termination of the Contract. Such costs incurred by Owner will be determined by Owner and confirmed by Architect."

After 14.2.4 add: new paragraph 14.2.5, 14.2.6, and 14.2.7 as follows:

14.2.5 In addition to Owner's right to remove Contractor from any part of Work pursuant to the Contract Documents, Owner may, at any time, at will and without cause, terminate any part of Work or any subcontract or all remaining Work for any reason whatsoever by giving seven (7) days' prior written notice to Contractor specifying the part of Work or subcontract to be terminated and the effective date of termination. Contractor shall continue to prosecute the part of Work not terminated. If any part of Work or subcontract is so terminated, Contractor shall be entitled to payment for Work properly executed in accordance with the Contract Documents (the basis for such payment shall be as provided in the Contract) and for costs directly related to Work

thereafter performed by Contractor in terminating such Work or subcontract including reasonable demobilization and cancellation charges provided said Work is authorized in advance by Architect and Owner. No payment shall be made by Owner; however, to the extent that such Work or subcontract is, was, or could have been terminated under the Contract Documents or an equitable adjustment is made or denied under another provision of the Contract. In case of such termination, Owner will issue a Construction Change Directive or authorize a Change Order making any required adjustment to the Date of Substantial Completion and/or the Contract Sum. For the remainder of the Work, the Contract Documents shall remain in full force and effect.

14.2.6 Owner shall not be responsible for damages for loss of anticipated profits on Work not performed on account of any termination described in Subparagraph 14.2.5.

14.2.7 Upon a determination by a court of competent jurisdiction that termination of Contractor pursuant to Subparagraph 14.2.1 was wrongful, such termination will be deemed converted to a termination for convenience pursuant to Subparagraph 14.2.5 and Contractor's remedy for wrongful termination shall be limited to the recovery of the payments permitted for termination for convenience as set forth in Subparagraph 14.2.5."

ARTICLE 15 – CLAIMS AND DISPUTES

15.1.1 Definitions

In line 1 after "matter of right" insert "adjustment or interpretation of the Contract Terms" and after "payment of money" insert, "extension of time,". After the second sentence insert, "Claims must be by written notice."

15.1.2 Notice of Claims

At the end of the paragraph insert the following, "Said written notice of claims shall state specifically the reason for the claim, the date or dates of the cause of causes of the claim, and if any extension of time is requested, the number of days of extension requested."

15.1.4 Claims for Additional Cost

After the first sentence insert the following, "Said notice shall itemize all claims and shall contain sufficient detail and substantiating data to permit evaluation of same by Owner and Architect. No such claim shall be value unless so made."

15.1.5 Claims for Additional Time

15.1.5.2 At the end of the paragraph and the sentence, "Such claims shall be given to the Owner within fourteen (14) days after the occurrence of the event justifying the claim.

After **15.1.5.2**, add new “15.1.5.3, 15.1.5.3.1, 15.1.5.3.2, 15.1.5.3.3, and 15.1.5.3.4 as follows

15.1.5.3 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions at the Project and that they had an adverse effect on the critical path of the construction schedule. The Contract Time shall not be extended nor shall the Contract Sum be increased, due to any adverse weather conditions experienced unless (a) the total number of weather-caused days of delay exceeds the Anticipated Weather Days, and (b) the critical path is delayed as a direct result of such adverse weather.

15.1.5.3.1 Anticipated Weather Days: An Allowance of approximately Twenty (20) Regular Work Days, established as probable days lost due to weather delays; said allowance shall be included in the Contractor’s proposed Completion Time in the Proposal.

15.1.5.3.2 Evaluation of Delay Days: The Owner will evaluate delays claimed by the Contractor based on the Critical path of the Contractor’s construction schedule, and if it is determined by the Owner that a critical path task has been delayed due to circumstances beyond the Contractor’s control, the accepted delay days will be deducted from the Anticipated Weather Delay Day Allowance.

15.1.5.3.3 Weather Days: Regular Work Days when rain, flooding snow, unusually high winds, excessively wet grounds or similar circumstances prevent progress on critical path of the Work. The Contractor will be entitled to an extension of the Contract Time for the net additional time, if any, which results from deducting the amount of Anticipated Weather Days from the total amount of actual Weather Days.

15.1.5.3.4 Net Weather Days: The difference in working days between the total amount of Anticipated Weather Days and total amount of Weather Days incurred.

15.1.6 Claims for Consequential Damages

Delete paragraph in its entirety and insect the following in lieu thereof, “Contractor shall not be entitled to claims for additional time and/or increase in Contract Price due to a problem or non-performance of a subcontractor.”

Insert new 15.1.7 as follow:

15.1.7 In the event the Contractor fails to achieve Substantial Completion by the date indicated in the Contract, and extended approved Change Order, the Owner shall be entitled to liquidated damages in the amount as stated in Subparagraph 3.1.1 of the modified AIA document A 101 - 2007 Edition by and between Owner and Contractor dated of even date herewith per day until the Work is substantially completed. 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 Owner in the event that the Work is not completed within the agreed time, or within the legally extended time, if any. Said sum shall be considered as liquidated damages only, the exact ascertainment of which is difficult and in no sense be considered a penalty.

15.2 Initial Decision

15.2.2 In line 3 after "Approve the Claim" insert "in whole or in part".

15.2.5 In line 6 delete "binding dispute resolution" and insert "litigation".

15.2.6 Delete in its entirety.

15.2.6.1 Delete in its entirety.

15.2.8 Delete in its entirety.

15.3 Mediation

15.3.1 In line 1 delete "except those waived as provided for in Sections 9.10.4, 9.10.5 and 15.1.6". In line 2 delete "binding dispute resolution" and insert "litigation".

15.3.2 Delete in its entirety and insert the following "The parties shall endeavor to resolve their Claims by mediation. 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."

15.3.3 In line 1 delete "and any filing fees equally".

15.4 Arbitration

Delete 15.4.1, 15.4.1.1, 15.4.2, and 15.4.3 in their entirety and insert the following in lieu thereof, "The parties expressly agree that disputes or claims arising under the Contract Documents shall not be subject to arbitration unless mutually agreed by the parties in writing."

15.4.4 Consolidation or Joinder

Delete 15.4.4.1, 15.4.4.2 and 15.4.4.3 in their entirety.

AIA® Document A101™ – 2007

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)

Idea Public Schools
2115 W. Pike Blvd.
Weslaco, Texas 78596

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

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

AIA Document A201™–2007, 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.

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

Idea Public Schools Brownsville Robindale
Brownsville, Texas

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

Gomez Mendez Saenz, Inc.
1150 Paredes Line Rd.
Brownsville, Texas 78521
Telephone Number: 9565460110
Fax Number: 9565460196

The Owner and Contractor agree as follows.

Init.
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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 the date of this Agreement unless a different date is stated below or provision is made for the date to be fixed in a notice to proceed issued by the Owner.
(Insert the date of commencement if it differs from the date of this Agreement or, if applicable, state that the date will be fixed in a notice to proceed.)

If, prior to the commencement of the Work, the Owner requires time to file mortgages and other security interests, the Owner's time requirement shall be as follows:

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

§ 3.3 The Contractor shall achieve Substantial Completion of the entire Work not later than ( ) days from the date of commencement, or as follows:
(Insert number of calendar days. Alternatively, a calendar date may be used when coordinated with the date of commencement. If appropriate, insert requirements for earlier Substantial Completion of certain portions of the Work.)

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User Notes: (3B9ADA18)

Portion of Work	Substantial Completion Date

, subject to adjustments of this Contract Time as provided in the Contract Documents.
(Insert provisions, if any, for liquidated damages relating to failure to achieve Substantial Completion on time or for bonus payments for early completion of the Work.)

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 The Contract Sum is based upon the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:
(State the numbers or other identification of accepted alternates. If the bidding or proposal documents permit the Owner to accept other alternates subsequent to the execution of this Agreement, attach a schedule of such other alternates showing the amount for each and the date when that amount expires.)

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

Item	Units and Limitations	Price Per Unit ($0.00)

§ 4.4 Allowances included in the Contract Sum, if any:
(Identify allowance and state exclusions, if any, from the allowance price.)

Item	Price

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 day of a month, the Owner shall make payment of the certified amount to the Contractor not later than the day of the month. If an Application for Payment is received by the Architect after the application date fixed above, payment shall be made by the Owner not later than ( ) 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, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment.

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§ 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 Subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

.1 Take that portion of the Contract Sum properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the Contract Sum allocated to that portion of the Work in the schedule of values, less retainage of percent (%). Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute shall be included as provided in Section 7.3.9 of AIA Document A201™–2007, General Conditions of the Contract for Construction;

.2 Add 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), less retainage of percent (%);

.3 Subtract the aggregate of previous payments made by the Owner; and

.4 Subtract amounts, if any, for which the Architect has withheld or nullified a Certificate for Payment as provided in Section 9.5 of AIA Document A201–2007.

§ 5.1.7 The progress payment amount determined in accordance with Section 5.1.6 shall be further modified under the following circumstances:

.1 Add, upon Substantial Completion of the Work, a sum sufficient to increase the total payments to the full amount of the Contract Sum, less such amounts as the Architect shall determine for incomplete Work, retainage applicable to such work and unsettled claims; and
(Section 9.8.5 of AIA Document A201–2007 requires release of applicable retainage upon Substantial Completion of Work with consent of surety, if any.)

.2 Add, if final completion of the Work is thereafter materially delayed through no fault of the Contractor, any additional amounts payable in accordance with Section 9.10.3 of AIA Document A201–2007.

§ 5.1.8 Reduction or limitation of retainage, if any, shall be as follows:
(If it is intended, prior to Substantial Completion of the entire Work, to reduce or limit the retainage resulting from the percentages inserted in Sections 5.1.6.1 and 5.1.6.2 above, and this is not explained elsewhere in the Contract Documents, insert here provisions for such reduction or limitation.)

§ 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 Section 12.2.2 of AIA Document A201–2007, 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:

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 INITIAL DECISION MAKER

The Architect will serve as Initial Decision Maker pursuant to Section 15.2 of AIA Document A201–2007, unless the parties appoint below another individual, not a party to this Agreement, to serve as Initial Decision Maker.

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(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

§ 6.2 BINDING DISPUTE RESOLUTION

For any Claim subject to, but not resolved by, mediation pursuant to Section 15.3 of AIA Document A201–2007, the method of binding dispute resolution shall be as follows:
(Check the appropriate box. If the Owner and Contractor do not select a method of binding dispute resolution below, 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.)

[ ] Arbitration pursuant to Section 15.4 of AIA Document A201–2007

[ ] Litigation in a court of competent jurisdiction

[ ] Other *(Specify)*

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 A201–2007.

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2007.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2007 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 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.)

%

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

Idea Public Schools
2115 W. Pike Blvd.
Weslaco, Texas 78596

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

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

§ 8.6 Other provisions:

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 The Contract Documents, except for Modifications issued after execution of this Agreement, are enumerated in the sections below.

§ 9.1.1 The Agreement is this executed AIA Document A101–2007, Standard Form of Agreement Between Owner and Contractor.

§ 9.1.2 The General Conditions are AIA Document A201–2007, General Conditions of the Contract for Construction.

§ 9.1.3 The Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

§ 9.1.4 The Specifications:
(Either list the Specifications here or refer to an exhibit attached to this Agreement.)

Section	Title	Date	Pages

§ 9.1.5 The Drawings:
(Either list the Drawings here or refer to an exhibit attached to this Agreement.)

Number	Title	Date

§ 9.1.6 The Addenda, if any:

Number	Date	Pages

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

§ 9.1.7 Additional documents, if any, forming part of the Contract Documents:

.1 AIA Document E201™–2007, Digital Data Protocol Exhibit, if completed by the parties, or the following:

.2 Other documents, if any, listed below:

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(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201–2007 provides that bidding requirements such as advertisement or invitation to bid, Instructions to Bidders, sample forms and the Contractor's bid are not part of the Contract Documents unless enumerated in this Agreement. They should be listed here only if intended to be part of the Contract Documents.)

ARTICLE 10 INSURANCE AND BONDS

The Contractor shall purchase and maintain insurance and provide bonds as set forth in Article 11 of AIA Document A201–2007.

(State bonding requirements, if any, and limits of liability for insurance required in Article 11 of AIA Document A201–2007.)

Type of insurance or bond	Limit of liability or bond amount ($0.00)

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

OWNER *(Signature)*	**CONTRACTOR** *(Signature)*
(Printed name and title)	*(Printed name and title)*

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SUPPLEMENTARY CONDITIONS TO THE STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR AIA DOCUMENT A-101 2007

The Supplementary Conditions contain modifications and additions to the Standard Form of Agreement between Owner and Contractor, AIA Document A101—2007 Edition. Where any part of the AIA A101—2007 is modified or voided by the Supplementary Conditions, the unaltered portions shall remain in effect.

All references to the AIA A201—2007 shall mean the AIA Document AIA A201–2007 as modified by Owner.

ARTICLE 3 – DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

3.1.1 Liquidated Damages: Owner and Contractor recognize that time is of the essence in this Agreement and that Owner will suffer financial loss if the Work is not completed within the time specified in Paragraph 3.1 above, plus any extension thereof allowed in accordance with Article 8 of the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal proceeding, the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring such proof, Owner and Contractor agree that as liquidated damages for delay (but not as penalty) Contractor shall pay Owner One Thousand and 00/100 Dollars ($1,000.00) for each day that expires after the time specified in Paragraph 3.1 for Substantial Completion until the work is substantially complete.

ARTICLE 4 – CONTRACT SUM

4.4 Insert any allowances here.

ARTICLE 5 – PAYMENTS

5.1.3 Delete this paragraph in its entirety and replace with the following: "Contractor shall submit an Application for Payment to the Architect by the **1st** of the month. Architect shall have seven **(7) days** to approve or reject the application for payment. Owner shall pay Contractor within **30 days** of receipt of an approved Application of Payment from the Architect. If an Application for Payment is received by the Architect after the application date fixed above, payment shall be made by the Owner no later than **30 days** after the Architect approves the Application for Payment. A draft pencil review of the Application for Payment prior to the approval date may be conducted to facilitate the approval process."

5.2.2 At the end of the paragraph delete "or as follows" and insert "and upon acceptance by the Owner and Architect, and after satisfactory evidence has been given by the Contractor that all his bills have been paid and the entire project is free from liens."

ARTICLE 6 DISPUTE RESOLUTION

6.2 Check the second box, "Litigation in a court of competent jurisdiction."

ARTICLE 8 MISCELLANEOUS PROVISIONS

8.6 Family Code Child Support Certification. By signing the Agreement, the Contractor certifies as follows: "Under Section 231.006, *Texas Family Code*, the vendor or applicant certifies that the individual or business entity named in this contract, bid, or application is not ineligible to receive the specified grant, loan, or payment and acknowledges that this contract may be terminated and payment may be withheld if this certification is inaccurate.".

8.7 Felony Conviction Notice - Section 44.034 of the Texas Education Code requires a person or business entity that enters into a contract with a school district must give advance notice to the district if the person or an owner or operator of the business entity has been convicted of a felony. The notice must include a general description of the conduct resulting in the conviction of a felony. Subsection (b) states,"... a school district may terminate a contract with a person or business entity if the district determines that the person or business entity failed to give notice as required by Subsection (a) or misrepresented the conduct resulting in the conviction. The district must compensate the person or business entity for the services performed before the termination of the contract." Subsection (c) states, "... this section does not apply to a publicly held corporation."

ARTICLE 10 – INSURANCE AND BONDS

After "written above" delete the "." and insert the following, "and is executed in three (3) original copies, of which one is to be delivered to the Contractor, one to the Architect for use in the administration of the Contract, and the remainder to the Owner.

PAYMENT BOND

KNOW ALL MEN BY PRESENTS, that _____

_____

as Principal, and _____ as Surety, are hereby held and firmly bound unto the Owner_____ in the penal sum of:_____

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

The conditions of this obligation are such that whereas the Principal entered into a certain contract hereto attached, and made a part hereof, with the Owner, said contract described as follows: _____

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

Now, therefor, 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 Article 5160 of the Revised Civil Statutes of Texas as amended by Acts of the 56th Legislature, Regular Session, 1959, and all liabilities of this bond shall be in accordance with the provisions of said Article to the same extent as if it were copied at length herein determined.

IN WITNESS WHEREOF, the above bounded parties have executed this instrument under their several 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 representative pursuant to authority of its governing body.

Principal: Surety:

By:_____ _____

PERFORMANCE BOND

KNOW ALL MEN BY PRESENTS, that _____

_____

as Principal, and _____ as Surety, are hereby held and firmly bound unto the Owner_____ in the penal sum of:_____ _____($_____) for the Payment, whereof, the said Principal and Surety (s) bind themselves, their heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

The conditions of this obligation are such that whereas the Principal entered into a certain contract hereto attached, and made a part hereof, with the Owner, said contract described as follows: _____ _____ which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

Now, therefor, 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 Article 5160 of the Revised Civil Statutes of Texas as amended by Acts of the 56th Legislature, Regular Session, 1959, and all liabilities of this bond shall be in accordance with the provisions of said Article to the same extent as if it were copied at length herein determined.

In the event Principal is in default under the contract as defined herein, Surety (s) will within fifteen (15) days of determination of such default take over and assume completion of said contract and become entitled to the Payment of the balance of the Contract price.

IN WITNESS WHEREOF, the above bounded parties have executed this instrument under their several 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 representative pursuant to authority of its governing body.

Principal: Surety:

By:_____ _____

RABA KISTNER

GEOTECHNICAL ENGINEERING STUDY

FOR

PROPOSED IDEA PUBLIC SCHOOL CAMPUS - ROBINDALE
BROWNSVILLE, CAMERON COUNTY, TEXAS

Raba Kistner
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TBPE Firm F-3257
TBPLS Firm 10193784

Project No. ABA18-002-00
February 19, 2018

Mr. Ernie Villarreal, Jr.
Project Management Services, Inc. (PMSI)
c/o IDEA Public Schools
900 Clarence Bohls Lane
Pflugerville, Texas 78660

RE: Geotechnical Engineering Study
Proposed IDEA Public School Campus – Robindale
Near the Southeast Corner of the Intersection of
Ruben M. Torres Boulevard (Farm-to-Market [F.M.] Road 802) and Robindale Road
Brownsville, Cameron County, Texas
IDEA Task Order No. TO #15 – IDEA Robindale

Dear Mr. Villarreal:

RABA KISTNER Consultants, Inc. (RKCI) is pleased to submit the report of our Geotechnical Engineering Study for the above-referenced project. This study was performed in general accordance with **RKCI** Proposal No. PBA18-002-00, dated January 18, 2018. Written authorization to proceed with this study was received by our office via electronic-mail attachment on Wednesday, January 31, 2018, by means of the Task Order No. 15 to the Master Agreement No. #Raba Kistner 7-23-13, dated January 18, 2018. The purpose of this study was to drill borings within the site proposed for the IDEA Public School campus, to perform laboratory testing on selected samples to classify and characterize subsurface conditions, and to prepare an engineering report presenting foundation and pavement recommendations and construction guidelines for the proposed educational campus.

The following report contains our foundation and pavement recommendations and construction considerations based on our current understanding of the design tolerances, and structural and pavement loads. If any of these parameters change, then there may be alternatives for value engineering of the foundation and pavement systems, and **RKCI** recommends that a meeting be held with PMSI, Inc. c/o IDEA Public Schools (CLIENT) and the design team to evaluate these alternatives.

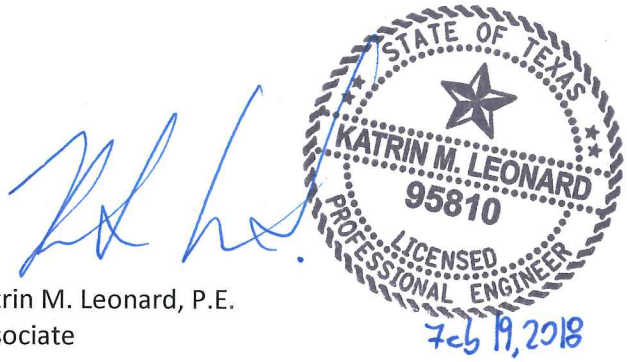
We appreciate the opportunity to be of professional service to you on this project. Should you have any questions about the information presented in this report, please call. We look forward to helping PMSI, Inc. c/o IDEA Public Schools during the construction of the project by conducting the construction materials engineering and testing services (quality assurance program).

Very truly yours,

RABA KISTNER CONSULTANTS, INC.



Saul Cruz
Graduate Engineer



Katrin M. Leonard, P.E.
Associate

Attachments

SC/KML

Copies Submitted: Above (1)
Gomez, Mendez, Saenz, Inc. (1)
Green, Rubiano & Associates (1)
Mejia & Rose, Inc. (1)

GEOTECHNICAL ENGINEERING STUDY

For

PROPOSED IDEA PUBLIC SCHOOL CAMPUS – ROBINDALE
NEAR THE SOUTHEAST CORNER OF THE INTERSECTION OF
RUBEN M. TORRES BOULEVARD (F.M. ROAD 802) AND ROBINDALE ROAD
BROWNSVILLE, CAMERON COUNTY, TEXAS
IDEA TASK ORDER NO. 15 – IDEA ROBINDALE

Prepared for

PROJECT MANAGEMENT SERVICES, INC.
c/o IDEA PUBLIC SCHOOLS
Pflugerville, Texas

Prepared by

RABA KISTNER CONSULTANTS, INC.
McAllen, Texas

PROJECT NO. ABA18-002-00

February 19, 2018

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Important Information About Your Geotechnical Engineering Report

INTRODUCTION

RABA KISTNER Consultants, Inc. (RKCI) has completed the authorized subsurface exploration and foundation and pavement recommendations for the proposed IDEA Pubic School campus to be located on an undeveloped tract of land, situated near the southeast corner of the intersection of Ruben M. Torres Boulevard (Farm-to-Market [F.M.] Road 802) and Robindale Road in Brownsville, Cameron County, Texas. This report briefly describes the procedures utilized during this study and presents our findings along with our recommendations for foundation and pavement design and construction considerations.

PROJECT DESCRIPTION

We understand that the proposed project consists of the design and construction of an IDEA Public School campus, to include an irregularly-shaped, educational building and its associated parking and driveway areas. Further, we understand that the project also includes the design and construction of a 1,200-ft long, asphalt-paved, street section of Ted Hunt Boulevard. The proposed IDEA Robindale school campus is planned to be located on an undeveloped tract of land, situated near the southeast corner of the intersection of Ruben M. Torres Boulevard (F.M. Road 802) and Robindale Road in Brownsville, Cameron County, Texas. The proposed educational building is expected to create relatively moderate loads to be carried by the foundation system, which is anticipated to consist of a shallow foundation system. The pavement systems are anticipated to consist of a combination of both flexible (asphalt) and rigid (concrete) pavements

On the basis of the topographical survey titled "IDEA Public Schools", dated February 1, 2017 provided to us by Mr. David Monreal with Gomez, Mendez, Saenz, Inc., the project's architectural firm, via electronic-mail transmittal on Friday, February 9, 2018, we understand that the ground surface elevations existing at the time of our study within the proposed educational building footprint area range from about 16.3 to 17.7 ft above mean sea level (MSL), and that the finished floor elevation (FFE) of the proposed educational building is planned to be 21.0 ft above MSL. Therefore, it is anticipated that, at a minimum, about 2.8 ft of suitable, select fill materials will be placed within the building footprint areas in order to achieve the proposed educational building's finished grade elevation (FGE) of about 20.5 ft above MSL, considering a 6-inch thick, concrete floor slab.

Further, based on the electronic-mail transmittal received by our office from the project's architectural firm on Monday, February 19, 2018, we understand that a traffic loading of 16 school buses twice a day, for five days a week, for a 20-year design period is anticipated for the proposed educational facility.

LIMITATIONS

This engineering report has been prepared in accordance with accepted Geotechnical Engineering practices in the region of South Texas for the use of PMSI, Inc. c/o IDEA Public Schools (CLIENT) and its representatives for design purposes. This report may not contain sufficient information for purposes of other parties or other uses and is not intended for use in determining construction means and methods.

The recommendations submitted in this report are based on the data obtained from 16 borings drilled within the subject site and our understanding of the project information provided to us by others. If the project information described in this report is incorrect, is altered, or if new information is available, we should be retained to review and modify our recommendations.

This report may not reflect the actual variations of the subsurface conditions across the subject site. The nature and extent of variations across the subject site may not become evident until construction commences. The construction process itself may also alter subsurface conditions. If variations appear evident at the time of construction, it may be necessary to reevaluate our recommendations after performing on-site observations and tests to establish the engineering impact of the variations.

The scope of our Geotechnical Engineering Study does not include an environmental assessment of the air, soil, rock, or water conditions either on or adjacent to the site. No environmental opinions are presented in this report. **RKCI**'s scope of work does not include the investigation, detection, or design related to the prevention of any biological pollutants. The term "biological pollutants" includes, but is not limited to, mold, fungi, spores, bacteria, and viruses, and the byproduct of any such biological organisms.

If final grade elevations are significantly different from the proposed site grading information provided to us by the project's architectural firm, our office should be informed about these changes. If needed and/or if desired, we will reexamine our analyses and make supplemental recommendations.

BORINGS AND LABORATORY TESTS

Subsurface conditions at the subject site were evaluated by 16 borings drilled within the site, as shown in the following table.

Proposed Structure	Number of Borings	Depth (ft) *	Boring Identification
Building Structures	6	25	B-1 through B-6
Parking and Driveway Areas	10	5	P-1 through P-10

* below the ground surface elevations existing at the time of our study.

The borings for the proposed educational campus (designated as "B-" and "P-") were drilled on January 24 and January 25, 2018 at the locations shown on the Boring Location Map, Figure 1. The boring locations are approximate and were located in the field by an **RKCI** representative based on a site plan titled "Overall Site Plan - IDEA Public School City of Brownsville", dated December 13, 2017 and provided to us by the CLIENT via electronic-mail attachment on January 16, 2018. The borings were drilled to the depths indicated in the previous table using a truck-mounted, rotary-drilling rig. The borings were conducted utilizing straight flight augers and were backfilled with the auger cuttings following completion of each day's drilling operations. During the drilling operations, Split-Spoon (with Standard Penetration Test, SPT) and Shelby tube samples were collected.

The SPT samples were performed in accordance with accepted standard practices and the penetration test results are presented as "blows per foot" on the boring logs. Representative portions of the samples were

sealed in containers to reduce moisture loss, labeled, packaged, and transported to our laboratory for subsequent testing and classification. Also, a bulk sample for the California Bearing Ratio (CBR) laboratory testing was collected from the pavement borings.

In the laboratory, each sample was evaluated and visually classified by a member of our Geotechnical Engineering staff in general accordance with the Unified Soil Classification System (USCS). The geotechnical engineering properties of the strata were evaluated by the following laboratory tests: natural moisture content, Atterberg limits, unconfined compressive strength determinations, a lime series determination, corrosivity testing (including electrical resistivity, pH, and sulfate and chloride content determinations), a CBR testing, and percent passing a No. 200 sieve determinations.

With the exception of the laboratory corrosivity (electrical resistivity, pH, and sulfate and chloride content determinations), lime series, and the laboratory CBR test results, the results of the field and laboratory tests are presented in graphical or numerical form on the boring logs illustrated on Figures 2 through 17. A key to the classification of terms and symbols used on the logs is presented on Figure 18. The results of the laboratory and field testing are also tabulated on Figure 19 for ease of reference.

The corrosion potential of the subsurface soils to concrete and uncoated steel was evaluated by conducting laboratory analyses (pH, electrical resistivity, sulfate content and chloride content) on a single soil sample obtained from the building footprint area, from an approximate depth of 1 ft below the ground surface elevations existing at the time of our study.

In addition to these tests, one laboratory CBR test was performed by combining the bulk soil samples collected from borings conducted within the pavement areas. This test was conducted to provide information regarding inundated strength, deflection, and swell characteristics of the subgrade soils for pavement analyses. The subgrade laboratory CBR value was evaluated using the American Society for Testing and Materials (ASTM) D698 Standard Proctor compaction testing procedures. The laboratory CBR test results are presented on Figure 20. Additionally, a lime series test was conducted to provide information regarding hydrated lime treatment of the subgrade soils in pavement areas.

SPT results are noted as “blows per ft” on the boring logs and on Figure 19, where “blows per ft” refers to the number of blows by a falling 140-lb (pound) hammer required for 1 ft of penetration into the subsurface materials.

Samples will be retained in our laboratory for 30 days after submittal of this report. Other arrangements may be provided at the written request of the CLIENT.

GENERAL SITE CONDITIONS

SITE DESCRIPTION

The subject site for the proposed educational campus is located near the southeast corner of the intersection of Ruben M. Torres Boulevard (F.M. Road 802) and Robindale Road in Brownsville, Cameron County, Texas. At the time of our field activities, the project site can be described as an undeveloped,

grass-covered tract of land, with an irrigation canal traversing the site in the east-west direction, at about 215 ft south of Ruben M. Torres Boulevard (F.M. Road 802). In general, the topography at the subject site is relatively flat, with a visually estimated vertical relief of about 3 ft across the site. Surface drainage is estimated to be poor. The subject sit is bounded to the north by Ruben M. Torres Boulevard (F.M. Road 802); to the south by Ted Hunt Boulevard; to the east by an undeveloped tract of land and few commercial buildings; and to the west by Robindale Road.

SITE GEOLOGY

A cursory review of the Geologic Atlas of Texas, (McAllen-Brownsville Sheet, dated 1976), published by the Bureau of Economic Geology at the University of Texas at Austin, indicates that the subject site appears to be located within Alluvium (floodplain) deposits consisting of clays, silts, sands, and gravel deposits of the Quaternary epoch (Holocene period).

According to the Soil Survey of Cameron County, Texas, published by the United States Department of Agriculture - Soil Conservation Service, in cooperation with the Texas Agricultural Experiment Station, the project site appears to be located within the Harlingen-Benito soil association consisting of level and nearly level, moderately well-drained to poorly-drained clays. The corresponding soil symbol appears to be BE, Benito clay.

SEISMIC COEFFICIENTS

Based upon a review of Section 1613 *Earthquake Loads* of the 2012 International Building Code (IBC), the following information has been summarized for seismic considerations associated with this site.

- Site Class Definition (Chapter 20 of the American Society of Civil Engineers [ASCE] 7): **Class D**. Based on the soil borings conducted for this investigation, the upper 100 feet of soil may be may be characterized as a stiff soil profile.
- Risk-Targeted Maximum Considered Earthquake Ground Motion Response Accelerations for the Conterminous United Stated of a 0.2-Second, Spectral Response Acceleration (5% of Critical Damping) (Figure 1613.3.1(1)): **S_s = 0.035g**. Note that the value taken from Figure 1613.3.1(1) is based on Site Class B and is adjusted as per 1613.3.3 below.
- Risk-Targeted Maximum Considered Earthquake Ground Motion Response Accelerations for the Conterminous United States of a 1-Second, Spectral Response Acceleration (5% of Critical Damping) (Figure 1613.3.1(2)): **S_1 = 0.013g**. Note that the value taken from Figure 1613.3.1(2) is based on Site Class B and is adjusted as per 1613.3.3 below.
- Value of Site Coefficient (Table 1613.3.3 (1)): *from worksheet* **F_a = 1.6**.
- Value of Site Coefficient (Table 1613.3.3 (2)): *from worksheet* **F_v = 2.4**.

The Maximum Considered Earthquake Spectral Response Accelerations are as follows:

- 0.2 sec., adjusted based on equation 16-37: *from worksheet* **S_{ms} = 0.056g**.
- 1 sec., adjusted based on equation 16-38: *from worksheet* **S_{m1} = 0.032g**.

The Design Spectral Response Acceleration Parameters are as follows:

- 0.2 sec., based on equation 16-39: *from worksheet* **S_{DS} = 0.037g**.
- 1 sec., based on equation 16-40: *from worksheet* **S_{D1} = 0.021g**.

Based on the parameters listed above, the critical nature of the structure, Tables 1613.3.5(1) and 1613.3.5(2), and calculations performed using a Java program titled, "Seismic Hazard Curves and Uniform Hazard Response Spectra" published by the United States Geological Survey (USGS) website, the Seismic Design Category for both short period and 1 second response accelerations is **A**. As part of the assumptions required to complete the calculations, a Risk Category of **III** was selected.

STRATIGRAPHY

The subsurface stratigraphy at this site can be described by two generalized strata. Each stratum has been designated by grouping soils that possess similar physical and engineering characteristics. For purposes of this report, we have designated the subsurface strata as Strata I and II. The lines designating the interfaces between strata on the boring logs represent approximate boundaries. Transitions between strata may be gradual.

It should be noted that Borings P-7 through P-10 were drilled on existing asphalt-paved road alignment. The existing hot mix asphaltic concrete (HMAC) thickness was measured to range from about 1-1/2 to 2 inches, while the flexible base material (FBM) thickness underlying the HMAC was measured to range from about 6 to 8 inches.

Stratum I consists of dark brown to brown to dark grayish-brown to grayish-brown to light brown, firm to stiff, fat clay soils and sandy fat clay soils. This layer was noted in Borings B-1, B-2, and B-4 from the ground surface elevations existing at the time of our study extending down to depths ranging from 20 to 23 ft. In rest of the borings, this layer was noted from the ground/pavement surface elevation existing at the time of our study extending at least the termination depth of those borings. Moisture contents were measured to range from about 25 to 28 percent for this layer. This stratum is classified as highly plastic, with measured plasticity indices ranging from 41 to 67 percent. Percent passing a No. 200 sieve tests demonstrate percent fines of about 61 to 98 percent for this layer. Two undrained shear strength values of about 0.7 and 1.0 ton per square foot (tsf) were measured, based on two unconfined compressive strength tests. Two unit dry weight values of about 90 and 92 pounds per cubic foot (pcf) were measured for this layer. SPT N-values ranging from 4 blows to 13 blows per foot of penetration were measured for this stratum. These soils are classified as CH soils in general accordance with the USCS.

Stratum II consists of brown, loose to medium dense, silty sand soils. This layer was noted only in Borings B-1, B-2, and B-4 from beneath the Stratum I soils, extending down to at least the termination depth of these borings. Moisture contents were measured to range from about 25 to 28 percent for this layer. This stratum is visually classified as marginally plastic. SPT N-values

ranging from 4 blows to 13 blows per foot of penetration were measured for this stratum. These soils may be classified as SM soils in general accordance with the USCS.

CORROSIVITY POTENTIAL

The corrosivity characteristics of the upper subsurface soils within the proposed building footprint area were preliminarily evaluated using a pH test, electrical resistivity test, sulfate content test, and chloride content test. This test was conducted on a single composite soil specimen obtained from the proposed educational building's footprint area, from the depth presented on the following table. Results are summarized in the following table:

Composite Sample Identification	Approximate Depth, ft *	Electrical Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (mg/kg)
Educational Building Pad Area	1	404.8	8.7	120	92.8

*below the ground surface elevations existing at the time of our study

The result of the laboratory electrical resistivity test conducted on the composite soil sample indicates an extremely corrosive potential for corrosion to buried metals. Laboratory chloride content test results indicated a moderately corrosive potential for corrosion to buried metals. According to the American Concrete Institute (ACI) document titled "Guide to Durable Concrete" (ACI 201), concrete usually provides protection against rusting of adequately embedded steel because of the strongly alkaline environment of the Portland cement paste. The adequacy of that protection is dependent upon the amount of the concrete cover, the quality of the concrete, the details of the construction, and the degree of exposure to chlorides from concrete-making components and external sources. It is recommended that no chloride-containing admixtures be utilized in the concrete mixes for this project. Consideration should also be given to implementing corrosion protection measures for buried metals in direct contact with the soil, such as coating metal structural elements, pipings, and/or fittings. The pH laboratory test results indicate that the surficial native soils are strongly alkaline. On the basis of the laboratory sulfate content test results, the subsurface soils appear to result in a mild exposure of concrete to corrosion. According to these laboratory test results, the native soils result in a Class 0 severity of potential exposure of concrete to corrosion. The ACI 201 Guide indicates no special cementitious material requirements for sulfate resistance for a Class 0 exposure.

GROUNDWATER

Groundwater was encountered during our drilling operations in Borings B-1 through B-6 at depths ranging from about 9 to 10-1/2 ft. The boreholes were left open for the duration of the field exploration phase to allow monitoring of water levels. It is possible for groundwater to exist beneath this site at shallower depths on a transient basis following periods of precipitation. Fluctuations in groundwater levels occur due to variations in rainfall and surface water run-off. The construction process itself may also cause variations in the groundwater level.

Based on the findings in the borings and on our experience in this region, we believe that groundwater seepage encountered during site earthwork activities and shallow foundation construction may be controlled using temporary earthen berm and conventional sump-and-pump dewatering methods.

FOUNDATION ANALYSES

EXPANSIVE, SOIL-RELATED MOVEMENTS

The anticipated ground movements due to swelling of the underlying soils at this site were estimated for slab-on-grade construction using the empirical procedure, Texas Department of Transportation (TxDOT) Tex-124-E, Method for Determining the Potential Vertical Rise (PVR). PVR values on the order of 4-1/4 inches were estimated for the stratigraphic conditions encountered in the borings. The PVR value was estimated using a surcharge load of 1 pound per square inch (psi) for the concrete slab and dry moisture conditions within the regional zone of seasonal moisture variation.

The TxDOT method of estimating expansive, soil-related movements is based on empirical correlations utilizing the measured plasticity indices and assuming typical seasonal fluctuations in moisture content. If desired, other methods of estimating expansive, soil-related movements are available, such as estimations based on swell tests and/or soil-suction analyses. However, the performance of these tests and the detailed analysis of expansive, soil-related movements were beyond the scope of the current study. It should also be noted that actual movements can exceed the estimated PVR values due to isolated changes in moisture content (such as due to leaks, landscape watering....) or if water seeps into the soils to greater depths than the assumed active zone depth due to deep trenching or excavations.

SETTLEMENTS

The subject site for the proposed educational campus is underlain by highly plastic, fat clay soils that are compressible. Low SPT N-values were observed in the borings from the ground surface elevations existing at the time of our study extending down to at least the termination depths of the borings conducted at this site. Based on the low shear strengths of these soils, the on-site soils have the potential for settlements under the applied structural loads. The potential settlements can only be estimated once the site grading plans, foundation dimensions, and structural loads have been established for this project.

It is important to note that the analyses of settlements and of the estimated PVR values are performed independent of each other. The estimated PVR values are determined based on the plasticity characteristics of the subsurface soils within the regional zone of seasonal moisture variation. The settlement potential is determined based on the in-place shear strength characteristics of the subsurface soils. Thus, the presence of soils that have the potential for volumetric changes with seasonal fluctuations in moisture content, combined with some soils being in a firm state, results in the potential for both PVR movements and settlements at this site.

PVR AND SETTLEMENT REDUCTION RECOMMENDATIONS

As mentioned previously, on the basis of the topographical survey titled "IDEA Public Schools", dated February 1, 2017 provided to us by the project's architectural firm, via electronic-mail attachment on Friday, February 9, 2018, we understand that the ground surface elevations existing at the time of our study within the proposed educational building footprint area range from about 16.3 to 17.7 ft above MSL, and that the FFE of the proposed educational building is planned to be 21.0 ft above MSL. Therefore, it is anticipated that, at a minimum, about 2.8 ft of suitable, select fill materials will be placed within the building footprint areas in order to achieve the proposed educational building's FGE of about 20.5 ft above MSL, considering a 6-inch thick, concrete floor slab.

To reduce expansive, soil-related movements in at-grade construction beneath the educational building footprint area to about 1 inch, as well as to strengthen and densify the surficial soils, we recommend the following site improvement procedure be implemented:

- Remove existing on-site clay soils down to EL. 13.5 ft. The excavation shall extend a minimum of 5 ft beyond the structure's perimeter.
- Proofroll the exposed subgrade as indicated in the *Site Preparation* subsection of the *Foundation Construction Considerations* section of this report.
- Once the proofrolling operations are complete and documented, place properly-compacted, suitable, select fill materials within the proposed building structure's footprint area up to its FGE of about 20.5 ft above MSL, in 6-inch compacted lifts. Each lift should be compacted, tested, and documented as indicated in the *Select Fill* subsection of the *Foundation Construction Considerations* section of this report.

Keep in mind that the estimated PVR values are computed based on the recommendations for the selection and placement of suitable, select fill materials which are addressed in the *Foundation Construction Considerations* section of the report.

Drainage Considerations When overexcavation and select fill replacement is selected as a method to reduce the potential for expansive, soil-related movements at any site, considerations of surface and subsurface drainage may be crucial to construction and adequate foundation performance of the soil-supported structure. Filling an excavation in relatively impervious clay soils with relatively pervious select fill material creates a "bathtub" beneath the structure, which can result in ponding or trapped water within the fill unless good surface and subsurface drainage is provided.

Water entering the fill surface during construction or entering the fill exposed beyond the structure lines after construction may create problems with fill moisture control during compaction and increased access for moisture to the underlying expansive clays both during and after construction.

Several surface and subsurface drainage design features and construction precautions can be used to limit problems associated with fill moisture. These features and precautions may include, but are not limited to, the following:

- Installing berms or swales on the uphill side of the construction areas to divert surface runoff away from the excavations/fill areas during construction;
- Sloping of the top of the subgrade with a minimum downward slope of 1.5 percent out to the base of a dewatering trench located beyond the structure's perimeter;
- Sloping the surface of the fill during construction to promote runoff of rain water to drainage features until the final lift is placed;
- Sloping of a final, well-maintained, impervious clay or pavement surface (downward away from the proposed educational building) over the select fill material and any perimeter drain extending beyond the buildings lines, with a minimum gradient of 6 in. in 5 ft;
- Constructing final surface drainage patterns to prevent ponding and limit surface water infiltration at and around the educational building's perimeter; and
- Locating the water-bearing utilities, roof drainage outlets, and irrigation spray heads outside of the select fill and perimeter drain boundaries.

Details relative to the extent and implementation of these considerations must be evaluated on a project-specific basis by all members of the project design team. Many variables that influence fill drainage considerations may depend on factors that are not fully developed in the early stages of design. For this reason, drainage of the fill should be given consideration at the earliest possible stages of the project.

FOUNDATION RECOMMENDATIONS

SITE GRADING

Site grading plans can result in changes in almost all aspects of foundation recommendations. We have prepared the foundation recommendations based on the site grading information provided to us by the CLIENT and the project's architectural firm, and the stratigraphic conditions encountered at the time of our study. If site grading plans differ from the information provided to us by others, we must be retained to review the site grading plans prior to bidding the project for construction. If needed and/or if desired, we will reexamine our analyses and make supplemental recommendations.

SHALLOW FOUNDATIONS

The proposed educational building may be founded on rigid-engineered beam and slab-on-fill foundations and/or on conventional spread and/or continuous footing foundations, provided that the shallow foundation type(s) can be designed to withstand the estimated soil-related movements (see the *Foundation Analyses* section of this report) without impairing either the structural or the operational performance of the educational building.

Allowable Soil-Bearing Capacity

Shallow foundations founded on new, properly-compacted, suitable, select fill materials, following the implementation of the ground improvement procedure presented in the *PVR and Settlement Reduction Recommendations* subsection of the *Foundation Analysis* section of this report may be proportioned using the design parameters shown in the following table:

Minimum depth below FGE:	24 in.
Minimum beam width:	12 in.
Maximum allowable soil-bearing pressure for continuous footings – grade beams:	1,700 psf
Maximum allowable soil-bearing pressure for spread footings – widened beams:	2,100 psf

Where psf = pounds per square feet

The maximum allowable soil-bearing pressures presented previously will provide a factor of safety of about 3 with respect to the measured soil shear strengths, provided that the subgrade is prepared in accordance with the recommendations outlined in the *Site Preparation* subsection of the *Foundation Construction Considerations* section of this report, and that the site improvement procedure included in the *PVR and Settlement Reduction Recommendations* subsection of the *Foundation Analyses* section of this report is implemented. Provided that the site improvement procedure recommended in this report is properly-implemented, then it is anticipated that total settlements will be in the order of about 1 inch. Differential settlements typically are estimated to be about one-half the total estimated settlement for most subsurface conditions.

Furthermore, the design parameters presented on the previous table are contingent upon the fill materials being selected and placed in accordance with the recommendations presented in the *Select Fill* subsection of the *Foundation Construction Considerations* section of this report. Should select fill selection and placement differ from the recommendations presented herein, **RKCI** should be informed of the deviations in order to reevaluate our recommendations and design criteria.

Wire Reinforcement Institute (WRI) Criteria

The slab-on-fill or on-grade shallow foundation may also be designed using WRI design criteria. On the basis of the subsurface stratigraphy encountered, a general effective plasticity index for the proposed educational building of 52 percent and a climatic rating (C_w) of 15 should be utilized for the design of the building's foundation.

AREA FLATWORK

It should be noted that ground-supported flatwork such as walkways, courtyards, sidewalks, etc., will be subject to the same magnitude of potential soil-related movements as discussed previously (see the *Foundation Analyses* section of this report). Thus, where these types of elements abut rigid building foundations or isolated structures, differential movements should be anticipated. As a minimum, we

recommend that flexible joints be provided where such elements abut the main structures to allow for differential movement at these locations. Where the potential for differential movement is objectionable, it may be beneficial to consider methods of reducing anticipated movements to match the adjacent building's performance.

FOUNDATION CONSTRUCTION CONSIDERATIONS

SITE DRAINAGE

Drainage is an important key to the successful performance of any foundation. Good surface drainage should be established prior to and maintained after construction to help prevent water from ponding within or adjacent to the educational building's foundation, and to facilitate rapid drainage away from the educational building's foundation. Failure to provide positive drainage away from the structure can result in localized differential vertical movements in the soil-supported foundation and floor slab.

Current ordinances, in compliance with the Americans with Disabilities Act (ADA), may dictate maximum slopes for walks and drives around and into new buildings. These slope requirements can result in drainage problems for buildings supported on expansive soils. We recommend that, on all sides of the educational building, the maximum permissible slope be provided away from the educational building structure.

Also, to help control drainage in the vicinity of the proposed educational building, we recommend that roof/gutter downspouts and landscaping irrigation systems not be located adjacent to the educational building's foundation. Where a select fill overbuild is provided outside of the floor slab/foundation footprints, the surface should be sealed with an impermeable layer (pavement or clay cap) to reduce infiltration of both irrigation and surface waters. Careful consideration should also be given to the location of water bearing utilities, as well as to provisions for drainage in the event of leaks in water bearing utilities. Leaks should be immediately repaired.

Other drainage and subsurface drainage issues are discussed in the *Foundation Analyses* section of this report.

SITE PREPARATION

The educational building area and all areas to support select fill should be stripped of all vegetation and/or organic topsoil down to a minimum depth of 8 inches and extending a minimum of 5 ft beyond the structure's footprint area. Further, we recommend that the site improvement procedures presented in the *PVR and Settlement Reduction Recommendations* section of this report be implemented to reduce the estimated expansive, soil-related movements to about 1 inch, as well as to strengthen and densify the surficial subgrade soils.

As mentioned previously, an irrigation ditch was noted traversing the site in the east-west direction, located about 215 ft south of Ruben M. Torres Boulevard (F.M. Road 802). We recommend that the area be stripped of all vegetation and organic topsoil, prior to placing any fill material within the ditch

alignment. We recommend that the ditch be backfilled in 6-inch compacted lifts. For the portions of the ditch located within the building footprint area, the backfill material may consist of on-site material up to EL. 13.5 ft. We recommend that properly-compacted, suitable, select fill material be used within the ditch area up to the proposed finished grade elevation of the building. For the portions of the ditch located within the non-building areas, the backfill material may consist of on-site material up to the proposed finished grade elevation assigned for that area. Stair-stepped approach, not exceeding 5:1 (horizontal:vertical) slopes, should be taken during backfill operations.

Exposed subgrades should be thoroughly proofrolled in order to locate and densify any weak, compressible zones. A minimum of 5 passes of a fully-loaded dump truck or a similar heavily-loaded piece of construction equipment should be used for planning purposes. Proofrolling operations should be observed by the Geotechnical Engineer or his/her representative to document subgrade conditions and preparation. Weak or soft areas identified during proofrolling should be treated with hydrated lime or Portland cement, or removed and replaced with a suitable, compacted select fill in accordance with the recommendations presented under the *Select Fill* subsection of this section of the report. If the treatment option is selected, the weak or soft areas may be mixed with hydrated lime or Portland cement down to a minimum depth of 8 inches in order to aid in drying the soils and develop a firm working surface. Proofrolling operations and any excavation/backfill activities should be observed by **RKCI** representatives to document subgrade preparation.

Upon completion of the proofrolling operations and just prior to fill placement, the exposed subgrades should be moisture-conditioned by scarifying to a minimum depth of 8 in. and recompacting to a minimum of 98 percent of the maximum dry density as determined from the American Society for Testing and Materials (ASTM) D698, Compaction Test. The moisture content of the subgrade should be maintained within the range of the optimum moisture content to three percentage points above the optimum moisture content until permanently covered.

SELECT FILL

Materials used as select fill for final site grading preferably should be crushed stone or gravel aggregate. We recommend that materials specified for use as select fill meet the TxDOT 2014 Standard Specification for Construction and Maintenance of Highways, Streets, and Bridges, Item 247, Flexible Base, Type A through Type E, Grades 1, 2, 3, and 5.

Alternatively, the following soils, as classified according to the USCS, may be considered satisfactory for use as select fill materials at this site: SC, GC, CL, and combinations of these soils. In addition to the USCS classification, alternative select fill materials shall have a maximum liquid limit of 40 percent, a plasticity index between 7 and 18 percent, and a maximum particle size not exceeding 4 inches or one-half the loose lift thickness, whichever is smaller. In addition, if these materials are utilized, grain size analyses and Atterberg Limits must be performed during placement at a minimum rate of one test each per 5,000 cubic yards of material due to the high degree of variability associated with pit-run materials.

If the above listed alternative materials are being considered for bidding purposes, the materials should be submitted to the Geotechnical Engineer for pre-approval a minimum of 10 working days or more prior to

the bid date. Failure to do so will be the responsibility of the General Contractor. The General Contractor will also be responsible for ensuring that the properties of all delivered alternate select fill materials are similar to those of the pre-approved submittal. It should also be noted that when using alternative fill materials, difficulties may be experienced with respect to moisture control during and subsequent to fill placement, as well as with erosion, particularly when exposed to inclement weather. This may result in sloughing of beam trenches and/or pumping of the fill materials.

Soils classified as CH, MH, ML, SM, GM, OH, OL, and Pt under the USCS and not meeting the alternative select fill material requirements, are **not** considered suitable for use as select fill materials at this site. The native soils at this site are **not** considered suitable for use as select fill materials.

Select fill should be placed in loose lifts **not** exceeding 8 in. in thickness and compacted to at least 98 percent of maximum dry density as determined by ASTM D698. The moisture content of the fill should be maintained within the range of two percentage points below the optimum moisture content to two percentage points above the optimum moisture content until the final lift of fill is permanently covered.

The select fill should be properly compacted in accordance with these recommendations and tested by **RKCI** personnel for compaction as specified.

SHALLOW FOUNDATION EXCAVATIONS

Shallow foundation excavations should be observed by the Geotechnical Engineer or his/her representative prior to placement of reinforcing steel and concrete. This is necessary to document that the bearing soils at the bottom of the excavations are similar to those encountered in the borings and that excessive soft materials and water are not present in the excavations. If soft soil pockets are encountered in the foundation excavations, they should be removed and replaced with a compacted non-expansive fill material or lean concrete up to the design foundation bearing elevation.

Disturbance from foot traffic and from the accumulation of excess water can result in losses in bearing capacity and increased settlement. If inclement weather is anticipated at the time construction, consideration should be given to protecting the bottoms of beam trenches by placing a thin mud mat (layer of flowable fill or lean concrete) at the bottom of trenches immediately following excavation. This will reduce disturbance from foot traffic and will impede the infiltration of surface water. All necessary precautions should be implemented to protect open excavations from the accumulation of surface water runoff and rain.

EXCAVATION SLOPING AND BENCHING

Excavations that extend to or below a depth of 5 ft below construction grade shall require the General Contractor to develop a trench safety plan to protect personnel entering the trench or trench vicinity. The collection of specific geotechnical data and the development of such a plan, which could include designs for sloping and benching or various types of temporary shoring, are beyond the scope of the current study. Any such designs and safety plans shall be developed in accordance with current Occupational Safety and Health Administration (OSHA) guidelines and other applicable industry standards.

To assist in preparing an excavation safety plan, we have classified the soils encountered along this site based on the data collected during this study. The on-site clay soils encountered above the groundwater levels within this site classified as Type "B" soils under current OSHA regulations pertaining to excavations. This classification is based on the observed cohesive nature of the soil, the unconfined compressive strength values obtained during field drilling operations, and the anticipated vibration from nearby traffic. In excavations penetrating these soils, the sloping and benching schemes specified for Type "B" soils under the OSHA regulations require that the excavation sidewalls be sloped no steeper than 1:1 (horizontal:vertical). The silty sand soils and the clay soils encountered below the groundwater levels within this site are classified as Type "C" soils under current OSHA regulations pertaining to excavations. In excavations penetrating these soils, the sloping and benching schemes specified for Type "C" soils under the OSHA regulations require that the excavation sidewalls be sloped no steeper than 1-1/2:1 (horizontal:vertical).

EXCAVATION EQUIPMENT

The boring logs are not intended for use in determining construction means and methods and may therefore be misleading if used for that purpose. We recommend that General Contractors and their subcontractors interested in bidding on the work perform their own tests in the form of test pits to determine the quantities of the different materials to be excavated, as well as the preferred excavation methods and equipment for this site.

UTILITIES

Utilities which project through slab-on-grade, slab-on-fill, "floating" floor slabs, or any other rigid unit should be designed with either some degree of flexibility or with sleeves. Such design features will help reduce the risk of damage to the utility lines.

Our experience indicates that significant settlement of backfill can occur in utility trenches, particularly when trenches are deep, when backfill materials are placed in thick lifts with insufficient compaction, and when water can access and infiltrate the trench backfill materials. The potential for water to access the backfill is increased where water can infiltrate flexible base materials due to insufficient penetration of curbs, and at sites where geological features can influence water migration into utility trenches. It is our belief that another factor which can significantly impact settlement is the migration of fines within the backfill into the open voids in the underlying free-draining bedding material.

To reduce the potential for settlement in utility trenches, we recommend that consideration be given to the following:

- Backfill materials should be placed and compacted in controlled lifts appropriate for the type of backfill and the type of compaction equipment being utilized and backfilling procedures should be tested and documented.
- Curbs should be installed to a sufficient depth to reduce water infiltration beneath the curbs into the pavement flexible base materials (see also the *Foundation Analyses* section of this report).

- Consideration should be given to wrapping free-draining bedding gravels with a geotextile fabric (similar to Mirafi 140N or CONTECH C-Drain Geocomposite) to reduce the infiltration and loss of fines from backfill material into the interstitial voids in bedding materials.

PAVEMENT RECOMMENDATIONS

Both flexible and rigid pavement recommendations for a 20-year design period are presented in this report. The CLIENT and/or design team may select either pavement type depending on the performance criteria established for the project. In general, flexible pavement systems have a lower initial construction cost as compared to rigid pavements. However, maintenance requirements over the life of the pavement are typically much greater for flexible pavements. This typically requires regularly-scheduled observation and repair, as well as overlays and/or other pavement rehabilitation at approximately one-half to two-thirds of the design life. Rigid pavements are generally more "forgiving", and therefore tend to be more durable and require less maintenance after construction.

For either pavement type, drainage conditions will have a significant impact on long-term performance, particularly where permeable flexible base materials are utilized in the pavement section. Drainage considerations are discussed in more detail in a subsequent section of this report.

SUBGRADE CONDITIONS

A single generalized subgrade condition has been assumed for this site. The predominant subgrade soils used in developing the pavement sections for this project are the surficial fat clay soils. A laboratory CBR value of 2.5 was measured for these subgrade soils under inundated conditions. On the basis of our past experience with similar subsurface conditions in this area, a design CBR value of 2.0 was assigned to evaluate the pavement components. This design CBR value assumes that the subgrade soils will be prepared in accordance with the recommendations stated in the *Subgrade Preparation* subsection of the *Pavement Construction Guidelines* section of this report.

LIME TREATMENT OF SUBGRADE

The subgrade soils at this site are plastic and can be difficult to work with, particularly during periods of inclement weather. The strength properties of the plastic subgrade clays may be increased by treating the upper 8 to 12 inches with hydrated lime. A sufficient quantity of lime should be mixed with the subgrade soils to decrease the plasticity index of the soil-lime mixture to 18 or less and to increase the pH of the soil-lime mixture to at least 12.4. The laboratory lime series testing performed for the subgrade clays indicates an optimum hydrated lime content of about 4 percent. For estimating purposes, we recommend that 5 percent lime by weight be used for lime treatment. For construction purposes, we recommend that the percent of hydrated lime treatment be determined by appropriate laboratory testing.

As stated previously, the potential of soluble sulfates in the subgrade clay soils within the study area was preliminary evaluated by conducting a single laboratory sulfate content test. The laboratory test result indicate a sulfate content value of about 120 parts per million (ppm). On the basis of this sulfate content

test result, the tested on-site clay soils do not appear to have a potential to cause sulfate-induced heave. Typically, the concentration of soluble sulfate on soils becomes a concern when the concentration reaches about 3,000 ppm and higher. The sulfate concentration in soils may vary over short distances, and as such, additional testing is recommended at the time of construction to confirm the concentration of sulfates in the exposed subgrade soils within the subject pavement areas.

DESIGN INFORMATION

The following recommendations for the pavement sections are based on our past experience with similar subgrade soils; traffic loadings provided by the project's architectural firm; a laboratory measured CBR value for the subgrade soils; and design procedures by the American Association of State Highway and Transportation Officials (AASHTO). The pavement design and analyses performed are based directly on the 1993 and 1997 editions of the "Guide for the Design of Pavement Structure" by AASHTO.

The pavement systems for the proposed educational facility can be divided into two general areas, each with different loading conditions and performance criteria. These areas are:

- Automobile drives and parking lots (light vehicular traffic);
- Driveways, bus lanes, and drive-in lanes (heavy vehicular traffic); and
- Ted Hunt Boulevard (reconstruction street alignment); and

For a 20-year design period, Equivalent Single Axle Loads (ESAL's) were estimated for an assumed traffic loading of 1 tractor-trailer truck per day for the light vehicular traffic areas. This corresponds to about 17,500 ESAL's. For the heavy vehicular traffic areas, ESAL's were estimated for an assumed traffic loading of 16 school buses twice a day, for five days a week, for a 20-year design period. This corresponds to about 266,500 ESAL's. For 10-year and 15-year design periods, traffic loadings of 100,000 ESAL's and 150,000 ESAL's, respectively, were assumed for the reconstruction of Ted Hunt Boulevard. It is recommended that the project Civil Engineer review the above-mentioned levels of traffic and design period to ensure that they are appropriate for the intended use of the proposed educational facility.

FLEXIBLE PAVEMENTS

The flexible pavement section alternatives shown on the following table are available for this site.

Pavement Area	Design Period (Years)	Alternative	LTS (in.)	FBM (in.)	HMAC (in.)
Automobile Drives and Parking Lots (Light Vehicular Traffic)	20	I	8	8	2
		II	8	6	2-1/2
Driveways, Bus Lanes, and Drive-in Lanes (Heavy Vehicular Traffic)	20	I	12	11-1/2	3
		II	12	9-1/2	3-1/2
Ted Hunt Boulevard (Heavy Vehicular Traffic)	10	I	12*	10	2
		II	12*	8	2-1/2
	15	I	12*	10	2-1/2
		II	12*	8	3

***The Lime-Treated Subgrade section may be substituted by a TENSAR TX5 geogrid or approved equivalent, placed at the interface of the prepared subgrade and the flexible base material section. If utilized, the TENSAR geogrid or approved equivalent must be installed in accordance with the manufacturer's specifications and recommendations.**

Where: LTS = Lime-Treated Subgrade
FBM = Flexible Base Material
HMAC = Hot-Mix Asphaltic Concrete Surface Course

The existing asphaltic concrete surface course and flexible base materials along the street alignment may be reused as flexible base materials, provided these existing materials are processed and treated in such a way as to comply with the requirements of the *Flexible Base Course* subsection of the *Pavement Construction Guidelines* section of this report. Care should be exercised as to not contaminate the existing HMAC and FBM materials with the underlying subgrade soils.

Garbage Dumpsters

Where flexible pavements are constructed at any site, it is recommended that reinforced concrete pads be provided in front of and beneath trash receptacles. The dumpster trucks should be parked on the concrete pads when the receptacles are lifted. It is suggested that such pads also be provided in drives where the dumpster trucks make turns with small radii to access the receptacles. The concrete pads at this site should be a minimum of 8 inches thick and reinforced with conventional steel reinforcing bars, and underlain by 8 inches of lime-treated subgrade.

RIGID PAVEMENTS

The following rigid pavement sections are available for this site:

Pavement Area	Design Period (Years)	Lime-Treated Subgrade (in.)	Reinforced Concrete (in.)
Automobile Drives and Parking Lots (Light Duty)	20	8	5-1/2
Driveways, Truck Lanes, and Drive-in Lanes (Heavy Duty)	20	8	8
Ted Hunt Boulevard (Heavy Duty)	10	8	6-1/2
	15	8	7

We recommend that the concrete pavements be reinforced with welded wire mats or bar mats. As a minimum, the welded wire mats should be 6 x 6 in., W4.0 x W4.0, and the bar mats should be No. 3 reinforcing bars spaced 18 in. on center in both directions. The concrete reinforcing should be placed approximately 1/3 the slab thickness below the surface of the slab, but not less than 2 in. The reinforcing should not extend across expansion joints.

Joints in concrete pavements aid in the construction and control the location and magnitude of cracks. Where practical, lay out the construction, expansion, control and sawed joints to form square panels, but not to exceed American Concrete Institute (ACI) 302.69 Code recommendations. The ratio of slab length-to-width should not exceed 1.25. Recommended joint spacings are 15 ft longitudinal and 15 ft transverse.

All control joints should be formed or sawed to a depth of at least 1/4 the thickness of the concrete slab. Sawing of control joints should begin as soon as the concrete will not ravel, generally the day after placement. Control joints may be hand formed or formed by using a premolded filler. We recommend that all longitudinal and transverse construction joints be dowelled to promote load transfer. Expansion joints are needed to separate the concrete slab from fixed objects such as drop inlets, light standards and buildings. Expansion joint spacings are not to exceed a maximum of 75 ft and no expansion or construction joints should be located in a swale or drainage collection locations.

If possible, the pavement should develop a minimum slope of 0.015 ft/ft to provide surface drainage. Reinforced concrete pavement should cure a minimum of 7 days before allowing any traffic.

PAVEMENT CONSTRUCTION CONSIDERATIONS

SUBGRADE PREPARATION

Areas to support pavements should be stripped of all vegetation and/or organic topsoil down to a minimum depth of 8 inches and extend a minimum of 2 ft beyond the pavement perimeters. Upon

completion of site stripping activities, the exposed subgrade should be thoroughly proofrolled in accordance with the *Site Preparation* subsection recommendations provided in the *Foundation Construction Considerations* section of this report. Likewise, upon completion of the proofrolling activities and just prior to select fill or flexible base placement, the exposed subgrade should be scarified and recompacted as recommended in such subsection.

DRAINAGE CONSIDERATIONS

As with any soil-supported structure, the satisfactory performance of a pavement system is contingent on the provision of adequate surface and subsurface drainage. Insufficient drainage which allows saturation of the pavement subgrade and/or the supporting granular pavement materials will greatly reduce the performance and service life of the pavement systems.

Surface and subsurface drainage considerations crucial to the performance of pavements at this site include (but are not limited to) the following:

1) Any known natural or man-made subsurface seepage at the site which may occur at sufficiently shallow depths as to influence moisture contents within the subgrade should be intercepted by drainage ditches or below grade French drains.
2) Final site grading should eliminate isolated depressions adjacent to curbs which may allow surface water to pond and infiltrate into the underlying soils. Curbs should completely penetrate flexible base materials and should be installed to sufficient depth to reduce infiltration of water beneath the curbs.
3) Pavement surfaces should be maintained to help minimize surface ponding and to provide rapid sealing of any developing cracks. These measures will help reduce infiltration of surface water downward through the pavement section.

ON-SITE CLAY FILL

The pavement recommendations presented in this report were prepared assuming that on-site soils will be used for site grading in the proposed pavement areas. If used, we recommend that on-site soils be placed in loose lifts not exceeding 8 in. in thickness and compacted to a minimum of 98 percent of the maximum dry density as determined from ASTM D698. The moisture content of the subgrade should be maintained within the range of two percentage points below the optimum moisture content to two percentage points above the optimum moisture content until permanently covered. We recommend that on-site fill materials be free of roots, vegetation, and/or other organic or degradable material. We also recommend that the maximum particle size not exceed 4 in. or one half the lift thickness, whichever is smaller.

SELECT FILL

If implemented, select fill materials utilized for achieving finished subgrade elevations in pavement areas should be in accordance with the *Select Fill* subsection recommendations provided in the *Foundation Construction Considerations* section of this report.

LIME TREATMENT OF SUBGRADE

Lime treatment of the subgrade soils should be in accordance with the TxDOT 2014 Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, Item 260, Lime Treatment (Road-Mixed). Lime-treated subgrade soils should be compacted to a minimum of 95 percent of the maximum dry density at a moisture content within the range of two percentage points below the optimum moisture content to two percentage points above the optimum moisture content as determined by ASTM D1557.

GEOGRID REINFORCEMENT

If utilized, the geogrid reinforcement should be Tensar TX5 or approved equivalent. Alternate materials may not be considered unless submitted to the Geotechnical Engineer for approval 10 days prior to bid date. Such submittals must include a physical sample and a report of documented physical properties, including but not limited to laboratory measured torsional rigidity (COE Method), junction strength and junction efficiency (GRI GGI-87), tensile strength (ASTM D-6637-01), and tensile modulus (GRI GGI-87). In addition, submittals must include results of full-scale laboratory testing or in-ground testing quantifying the structural contribution of the geogrid to a pavement structure.

FLEXIBLE BASE COURSE

The flexible base course should consist of material conforming to TxDOT 2014 Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, Item 247, Flexible Base, Type A through Type E, Grades 1, 2, 3, and 5.

The flexible base course should be placed in lifts with a maximum compacted thickness of 8 in. and compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D1557. The moisture content of the base course materials should be maintained within the range of three percentage points below the optimum moisture content to three percentage points above the optimum moisture content until permanently covered.

If the existing asphaltic concrete surface course and flexible base materials are being considered to be reused as flexible base materials, such materials should processed and treated in such a way as to comply with the TxDOT 2014 Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, Item 251, Reworking Base Courses.

ASPHALTIC CONCRETE SURFACE COURSE

The asphaltic concrete surface course should conform to TxDOT 2014 Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, Item 341, Dense-Graded Hot-Mix Asphalt, Type D. The asphaltic concrete should be compacted to a minimum of 92 percent of the maximum theoretical specific gravity (Rice) of the mixture determined according to Test Method Tex-227-F. Pavement specimens, which shall be either cores or sections of asphaltic pavement, will be tested according to Test Method Tex-207-F. The nuclear-density gauge or other methods which correlate

satisfactorily with results obtained from project roadway specimens may be used when approved by the Engineer. Unless otherwise shown on the plans, the Contractor shall be responsible for obtaining the required roadway specimens at their expense and in a manner and at locations selected by the Engineer.

PORTLAND CEMENT CONCRETE

The Portland cement concrete pavement should be air entrained to result in a 4 percent plus/minus 1 percent air, should have a maximum slump of 5 inches, and should have a minimum 28-day compressive strength of 3,500 psi. A liquid membrane-forming curing compound should be applied as soon as practical after broom finishing the concrete surface. The curing compound will help reduce the loss of water from the concrete. The reduction in the rapid loss in water will help reduce shrinkage cracking of the concrete.

CONSTRUCTION RELATED SERVICES

CONSTRUCTION MATERIALS ENGINEERING AND TESTING SERVICES

As presented in the attachment to this report, *Important Information About Your Geotechnical Engineering Report*, subsurface conditions can vary across a project site. The conditions described in this report are based on interpolations derived from a limited number of data points. Variations will be encountered during construction, and only the geotechnical design engineer will be able to determine if these conditions are different than those assumed for design.

Construction problems resulting from variations or anomalies in subsurface conditions are among the most prevalent on construction projects and often lead to delays, changes, cost overruns, and disputes. These variations and anomalies can best be addressed if the geotechnical engineer of record, **RABA KISTNER Consultants, Inc.**, is retained to perform the construction materials engineering and testing services during the construction of the project. This is because:

- **RKCI** has an intimate understanding of the geotechnical engineering report's findings and recommendations. **RKCI** understands how the report should be interpreted and can provide such interpretations on site, on the CLIENT's behalf.
- **RKCI** knows what subsurface conditions are anticipated at the site.
- **RKCI** is familiar with the goals of the CLIENT and the project's design professionals, having worked with them in the development of the project's geotechnical design workscope. This enables **RKCI** to suggest remedial measures (when needed) which help meet others' requirements.
- **RKCI** has a vested interest in client satisfaction, and thus assigns qualified personnel whose principal concern is client satisfaction. This concern is exhibited by the manner in which contractors' work is tested, evaluated and reported, and in selection of alternative approaches when such may become necessary.
- **RKCI** cannot be held accountable for problems which result due to misinterpretation of our findings or recommendations when we are not on hand to provide the interpretation which is required.

BUDGETING FOR CONSTRUCTION TESTING

Appropriate budgets need to be developed for the required construction materials engineering and testing services. At the appropriate time before construction, we advise that **RKCI** and the project designers meet and jointly develop the testing budgets, as well as review the testing specifications as it pertains to this project.

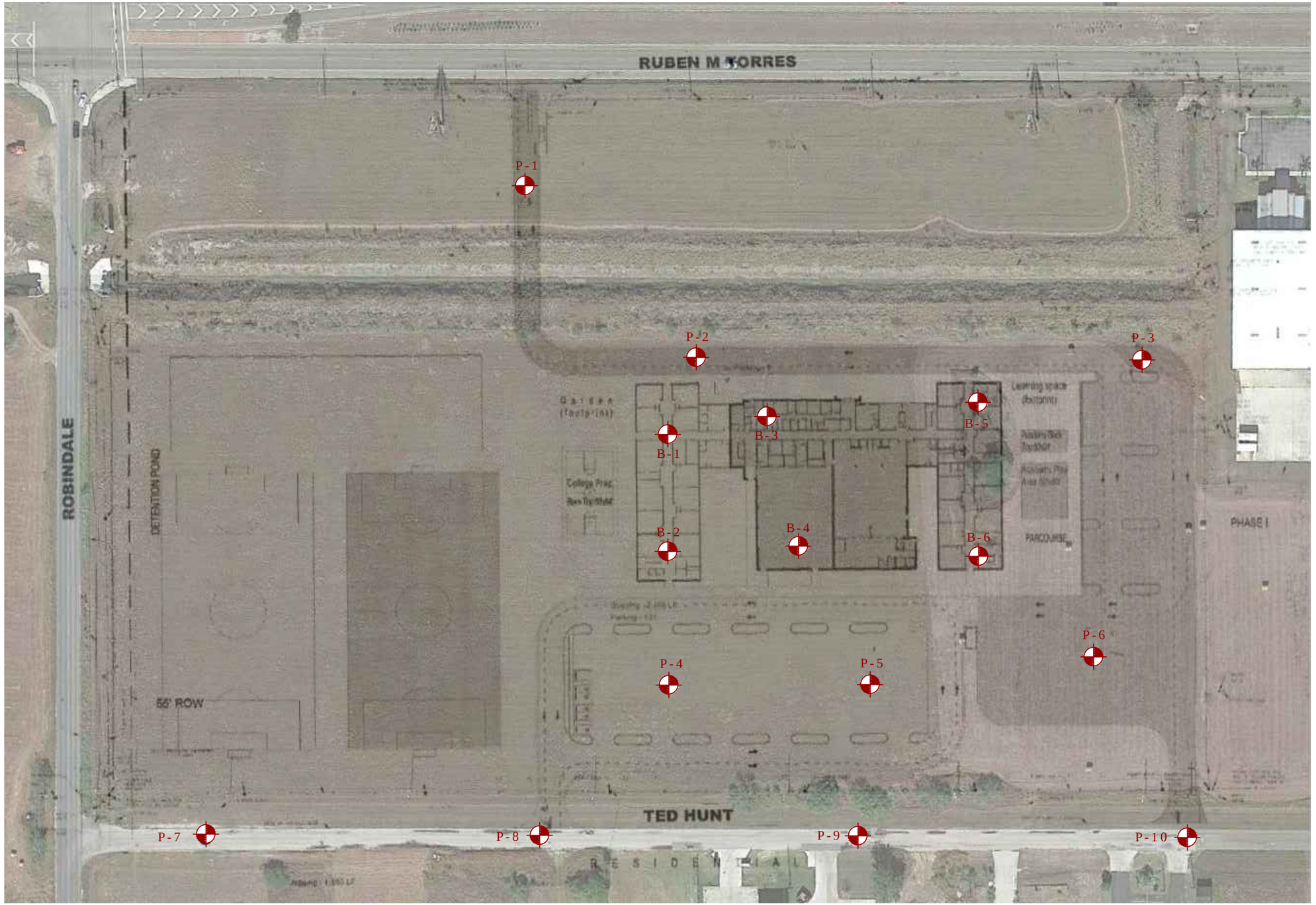
Once the construction testing budget and scope of work are finalized, we encourage a preconstruction meeting with the selected General Contractor to review the scope of work to make sure it is consistent with the construction means and methods proposed by the General Contractor. **RKCI** looks forward to the opportunity to provide continued support on this project, and would welcome the opportunity to meet with the Project Team to develop both a scope and budget for these services.

* * * * * * * * * * * * * * * * * *

The following figures are attached and complete this report:

Figure 1	Boring Location Map
Figures 2 through 17	Logs of Borings
Figure 18	Key to Terms and Symbols
Figure 19	Results of Soil Sample Analyses
Figure 20	Moisture-Density Relationship Test (with CBR Laboratory Test Results)
Figure 21	Lime Series Determination

ATTACHMENTS



RABA KISTNER CONSULTANTS
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Facilities • Infrastructure

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TBPE Firm F-3257

BORING LOCATION MAP
IDEA PUBLIC SCHOOL
CAMPUS - ROBINDALE

SOUTHEAST CORNER OF
RUBEN M. TORRES BLVD & ROBINDALE RD
BROWNSVILLE, CAMERON COUNTY, TEXAS

REVISIONS:

No.	DATE	DESCRIPTION

PROJECT No.:	ABA18-002-00
ISSUE DATE:	01-29-18
DRAWN BY:	DV
CHECKED BY:	SC
REVIEWED BY:	KML

FIGURE
1

© 2010 by Raba-Kistner Consultants, Inc.

C:\Active Projects\McAllen\2018\ABA18\ABA18-002-00 Prop. IDEA Robindale - Brownsville\Drawings\Figure 1 - 11x17.dwg

LOG OF BORING NO. B-1

Prop. IDEA Robindale School Campus
Southeast Corner of Ruben M. Torres Blvd & Robindale Rd
Brownsville, Cameron County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: See Figure 1

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
	SURFACE ELEVATION: Existing Grade ft				
	FAT CLAY firm to stiff to firm, dark brown, with calcareous nodules and black ferrous stains	5		58	
		13			97
5		7		43	
		8			
	SANDY FAT CLAY (CH) stiff to firm, brown	8			61
10					
	- becomes dark grayish-brown in color below a depth of about 15 ft	9			
15					
		4			
20					
	SILTY SAND (SM) loose, brown, saturated	6			
25	Boring terminated at a depth of about 25 ft.				
	NOTES: During the drilling operations, groundwater was encountered at a depth of about 10.5 ft.				
30					

SHEAR STRENGTH, TONS/FT²

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT

10 20 30 40 50 60 70 80

DEPTH DRILLED:	25.0 ft	**DEPTH TO WATER:**	10.5 ft	**PROJ. No.:**	ABA18-002-00
DATE DRILLED:	1/24/2018	**DATE MEASURED:**	1/24/2018	**FIGURE:**	2

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. B-2

Prop. IDEA Robindale School Campus
Southeast Corner of Ruben M. Torres Blvd & Robindale Rd
Brownsville, Cameron County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT^2 (0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0) PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70 80)	PLASTICITY INDEX	% -200
			SURFACE ELEVATION: Existing Grade ft					
			FAT CLAY firm to stiff, dark brown to brown, with calcareous nodules	6				93
				7			53	
5				9				96
					90		41	
10			**SANDY FAT CLAY (CH)** firm to stiff, brown	5				
15				9				67
20			**SILTY SAND (SM)** loose, brown, saturated	6				
				4				
25			Boring terminated at a depth of about 25 ft.					
			NOTES: During the drilling operations, groundwater was encountered at a depth of about 9.5 ft.					
30								

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED:	25.0 ft	**DEPTH TO WATER:**	9.5 ft	**PROJ. No.:**	ABA18-002-00
DATE DRILLED:	1/24/2018	**DATE MEASURED:**	1/24/2018	**FIGURE:**	3

LOG OF BORING NO. B-3

Prop. IDEA Robindale School Campus
Southeast Corner of Ruben M. Torres Blvd & Robindale Rd
Brownsville, Cameron County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: See Figure 1

SURFACE ELEVATION: Existing Grade ft

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT² (0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0; PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT; 10 20 30 40 50 60 70 80)	PLASTICITY INDEX	% -200
0			**FAT CLAY** firm to stiff, dark brown, with calcareous nodules	7		97	67	
				8				98
5							43	
				8				
			FAT CLAY (CH) firm to stiff to firm, brown, with black ferrous stains					
10				6				92
15				9				
20				5				
				6				
25			Boring terminated at a depth of about 25 ft.					
30			NOTES: During the drilling operations, groundwater was encountered at a depth of about 9 ft.					

DEPTH DRILLED:	25.0 ft	**DEPTH TO WATER:**	9 ft	**PROJ. No.:**	ABA18-002-00
DATE DRILLED:	1/24/2018	**DATE MEASURED:**	1/24/2018	**FIGURE:**	4

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. B-4

Prop. IDEA Robindale School Campus
Southeast Corner of Ruben M. Torres Blvd & Robindale Rd
Brownsville, Cameron County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: See Figure 1

SURFACE ELEVATION: Existing Grade ft

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT^2 (0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0; PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT; 10 20 30 40 50 60 70 80)	PLASTICITY INDEX	% -200
			FAT CLAY firm to stiff, dark brown to brown, with calcareous nodules	8				94
				6			49	
5				6				96
				9			44	
10			**SANDY FAT CLAY (CH)** firm to stiff, dark grayish-brown	7				
15				9				
20			**SILTY SAND (SM)** medium dense, brown, saturated	12				
				13				
25			Boring terminated at a depth of about 25 ft.					
			NOTES: During the drilling operations, groundwater was encountered at a depth of about 10 ft.					
30								

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED:	25.0 ft	**DEPTH TO WATER:**	10 ft	**PROJ. No.:**	ABA18-002-00
DATE DRILLED:	1/25/2018	**DATE MEASURED:**	1/25/2018	**FIGURE:**	5

LOG OF BORING NO. B-5

Prop. IDEA Robindale School Campus
Southeast Corner of Ruben M. Torres Blvd & Robindale Rd
Brownsville, Cameron County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: See Figure 1

SURFACE ELEVATION: Existing Grade ft

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
0	**FAT CLAY** firm, dark brown, with calcareous nodules	5		57	
		6			95
5	- becomes brown in color and with black ferrous stains below a depth of about 5 ft	7		42	
		7			
10	**FAT CLAY (CH)** stiff to firm, grayish-brown	9			92
15		8			
20		7			
25		5			
	Boring terminated at a depth of about 25 ft.				
	NOTES: During the drilling operations, groundwater was encountered at a depth of about 10 ft.				
30					

SHEAR STRENGTH, TONS/FT^2
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
PLASTIC LIMIT WATER CONTENT LIQUID LIMIT
10 20 30 40 50 60 70 80

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED:	25.0 ft	**DEPTH TO WATER:**	10 ft	**PROJ. No.:**	ABA18-002-00
DATE DRILLED:	1/25/2018	**DATE MEASURED:**	1/25/2018	**FIGURE:**	6

LOG OF BORING NO. B-6

Prop. IDEA Robindale School Campus
Southeast Corner of Ruben M. Torres Blvd & Robindale Rd
Brownsville, Cameron County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: See Figure 1

SURFACE ELEVATION: Existing Grade ft

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
0	**FAT CLAY** firm to stiff, dark brown, with calcareous nodules	5			91
			92	39	
5	- becomes brown in color below a depth of about 5 ft	10			
		8		47	
10	**SANDY FAT CLAY (CH)** stiff to firm, dark grayish-brown	7			66
15	- becomes brown in color below a depth of about 15 ft	9			
20		6			
	- becomes light brown in color below a depth of about 23 ft	8			
25	Boring terminated at a depth of about 25 ft.				
	NOTES: During the drilling operations, groundwater was encountered at a depth of about 9 ft.				
30					

SHEAR STRENGTH, TONS/FT²

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT

10 20 30 40 50 60 70 80

DEPTH DRILLED:	25.0 ft	**DEPTH TO WATER:**	9 ft	**PROJ. No.:**	ABA18-002-00
DATE DRILLED:	1/25/2018	**DATE MEASURED:**	1/25/2018	**FIGURE:**	7

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. P-1

Prop. IDEA Robindale School Campus
Southeast Corner of Ruben M. Torres Blvd & Robindale Rd
Brownsville, Cameron County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: See Figure 1

SURFACE ELEVATION: Existing Grade ft

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT^2 (0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0) PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70 80)	PLASTICITY INDEX	% -200
			FAT CLAY (CH) firm, dark brown	8			49	
				6				
5			Boring terminated at a depth of about 5 ft.					
			NOTES: Upon completion of the drilling operations, the boring was observed dry.					
10								
15								
20								
25								
30								

DEPTH DRILLED:	5.0 ft	**DEPTH TO WATER:**	DRY	**PROJ. No.:**	ABA18-002-00
DATE DRILLED:	1/25/2018	**DATE MEASURED:**	1/25/2018	**FIGURE:**	8

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. P-2

Prop. IDEA Robindale School Campus
Southeast Corner of Ruben M. Torres Blvd & Robindale Rd
Brownsville, Cameron County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT^2 (0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0; PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT; 10 20 30 40 50 60 70 80)	PLASTICITY INDEX	% -200
			SURFACE ELEVATION: Existing Grade ft					
			FAT CLAY (CH) stiff, dark brown	9			62	
				11				
5			Boring terminated at a depth of about 5 ft.					
			NOTES: Upon completion of the drilling operations, the boring was observed dry.					
10								
15								
20								
25								
30								

DEPTH DRILLED:	5.0 ft	**DEPTH TO WATER:**	DRY	**PROJ. No.:**	ABA18-002-00
DATE DRILLED:	1/25/2018	**DATE MEASURED:**	1/25/2018	**FIGURE:**	9

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. P-3

Prop. IDEA Robindale School Campus
Southeast Corner of Ruben M. Torres Blvd & Robindale Rd
Brownsville, Cameron County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger **LOCATION:** See Figure 1

SURFACE ELEVATION: Existing Grade ft

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT^2	PLASTICITY INDEX	% -200
			FAT CLAY (CH) firm, dark brown	8				
				7			52	
5			Boring terminated at a depth of about 5 ft.					
			NOTES: Upon completion of the drilling operations, the boring was observed dry.					
10								
15								
20								
25								
30								

SHEAR STRENGTH, TONS/FT^2: 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0

PLASTIC LIMIT WATER CONTENT LIQUID LIMIT

10 20 30 40 50 60 70 80

DEPTH DRILLED:	5.0 ft	**DEPTH TO WATER:**	DRY	**PROJ. No.:**	ABA18-002-00
DATE DRILLED:	1/25/2018	**DATE MEASURED:**	1/25/2018	**FIGURE:**	10

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. P-4

Prop. IDEA Robindale School Campus
Southeast Corner of Ruben M. Torres Blvd & Robindale Rd
Brownsville, Cameron County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger **LOCATION:** See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT^2	PLASTICITY INDEX	% -200
			SURFACE ELEVATION: Existing Grade ft			0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0		
						PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT		
						10 20 30 40 50 60 70 80		
			FAT CLAY (CH) firm, dark brown	8		96	64	
				8				
5			Boring terminated at a depth of about 5 ft.					
			NOTES: Upon completion of the drilling operations, the boring was observed dry.					
10								
15								
20								
25								
30								

DEPTH DRILLED:	5.0 ft	**DEPTH TO WATER:**	DRY	**PROJ. No.:**	ABA18-002-00
DATE DRILLED:	1/25/2018	**DATE MEASURED:**	1/25/2018	**FIGURE:**	11

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. P-5

Prop. IDEA Robindale School Campus
Southeast Corner of Ruben M. Torres Blvd & Robindale Rd
Brownsville, Cameron County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: See Figure 1

SURFACE ELEVATION: Existing Grade ft

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT^2 (0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0; PLASTIC LIMIT; WATER CONTENT; LIQUID LIMIT; 10 20 30 40 50 60 70 80)	PLASTICITY INDEX	% -200
			FAT CLAY (CH) firm, dark brown	6			58	
				8				
5			Boring terminated at a depth of about 5 ft.					
			NOTES: Upon completion of the drilling operations, the boring was observed dry.					
10								
15								
20								
25								
30								

DEPTH DRILLED:	5.0 ft	**DEPTH TO WATER:**	DRY	**PROJ. No.:**	ABA18-002-00
DATE DRILLED:	1/25/2018	**DATE MEASURED:**	1/25/2018	**FIGURE:**	12

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. P-6

Prop. IDEA Robindale School Campus
Southeast Corner of Ruben M. Torres Blvd & Robindale Rd
Brownsville, Cameron County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT^2	PLASTICITY INDEX	% -200
			SURFACE ELEVATION: Existing Grade ft					
			FAT CLAY (CH) firm to stiff, dark brown	8				
				10		92	64	
5			Boring terminated at a depth of about 5 ft.					
			NOTES: Upon completion of the drilling operations, the boring was observed dry.					
10								
15								
20								
25								
30								

SHEAR STRENGTH, TONS/FT^2: 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT

10 20 30 40 50 60 70 80

DEPTH DRILLED:	5.0 ft	**DEPTH TO WATER:**	DRY	**PROJ. No.:**	ABA18-002-00
DATE DRILLED:	1/25/2018	**DATE MEASURED:**	1/25/2018	**FIGURE:**	13

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. P-7

Prop. IDEA Robindale School Campus
Southeast Corner of Ruben M. Torres Blvd & Robindale Rd
Brownsville, Cameron County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT^2 (0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70 80)	PLASTICITY INDEX	% -200
			SURFACE ELEVATION: Existing Grade ft					
			Hot-Mix Asphaltic Concrete (HMAC) - 1-1/2 in.					
			Flexible Base Material (FBM) - 6 in.	9				
			FAT CLAY (CH) stiff, dark brown					
				8			49	
5			Boring terminated at a depth of about 5 ft.					
			NOTES: Upon completion of the drilling operations, the boring was observed dry.					
10								
15								
20								
25								
30								

DEPTH DRILLED:	5.0 ft	**DEPTH TO WATER:**	DRY	**PROJ. No.:**	ABA18-002-00
DATE DRILLED:	1/25/2018	**DATE MEASURED:**	1/25/2018	**FIGURE:**	14

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. P-8

Prop. IDEA Robindale School Campus
Southeast Corner of Ruben M. Torres Blvd & Robindale Rd
Brownsville, Cameron County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger **LOCATION:** See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT^2 (0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0)	PLASTICITY INDEX	% -200
			SURFACE ELEVATION: Existing Grade ft			PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70 80)		
			Hot-Mix Asphaltic Concrete (HMAC) - 1-3/4 in.					
			Flexible Base Material (FBM) - 7-1/2 in.	8			52	
			FAT CLAY (CH) stiff, dark brown					
				9				
5			Boring terminated at a depth of about 5 ft.					
			NOTES: Upon completion of the drilling operations, the boring was observed dry.					
10								
15								
20								
25								
30								

DEPTH DRILLED:	5.0 ft	**DEPTH TO WATER:**	DRY	**PROJ. No.:**	ABA18-002-00
DATE DRILLED:	1/25/2018	**DATE MEASURED:**	1/25/2018	**FIGURE:**	15

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. P-9

Prop. IDEA Robindale School Campus
Southeast Corner of Ruben M. Torres Blvd & Robindale Rd
Brownsville, Cameron County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT^2 (0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70 80)	PLASTICITY INDEX	% -200
			SURFACE ELEVATION: Existing Grade ft					
			Hot-Mix Asphaltic Concrete (HMAC) - 2 in.					
			Flexible Base Material (FBM) - 8 in.					
			FAT CLAY (CH) stiff, dark brown	8			49	
				8				
5			Boring terminated at a depth of about 5 ft.					
			NOTES: Upon completion of the drilling operations, the boring was observed dry.					
10								
15								
20								
25								
30								

DEPTH DRILLED:	5.0 ft	**DEPTH TO WATER:**	DRY	**PROJ. No.:**	ABA18-002-00
DATE DRILLED:	1/25/2018	**DATE MEASURED:**	1/25/2018	**FIGURE:**	16

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. P-10

Prop. IDEA Robindale School Campus
Southeast Corner of Ruben M. Torres Blvd & Robindale Rd
Brownsville, Cameron County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT^2	PLASTICITY INDEX	% -200
			SURFACE ELEVATION: Existing Grade ft					
			Hot-Mix Asphaltic Concrete (HMAC) - 1-1/2 in.					
			Flexible Base Material (FBM) - 8 in.	7			54	
			FAT CLAY (CH) firm, dark brown					
				7				
5			Boring terminated at a depth of about 5 ft.					
			NOTES: Upon completion of the drilling operations, the boring was observed dry.					
10								
15								
20								
25								
30								

SHEAR STRENGTH, TONS/FT^2: 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0

PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT: 10 20 30 40 50 60 70 80

DEPTH DRILLED:	5.0 ft	**DEPTH TO WATER:**	DRY	**PROJ. No.:**	ABA18-002-00
DATE DRILLED:	1/25/2018	**DATE MEASURED:**	1/25/2018	**FIGURE:**	17

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

KEY TO TERMS AND SYMBOLS

MATERIAL TYPES

SOIL TERMS


CALCAREOUS


CALICHE


CLAY


CLAYEY


GRAVEL


GRAVELLY


PEAT


SAND


SANDY


SILT


SILTY


FILL

ROCK TERMS


CHALK


CLAYSTONE


CLAY-SHALE


CONGLOMERATE


DOLOMITE


IGNEOUS


LIMESTONE


MARL


METAMORPHIC


SANDSTONE


SHALE


SILTSTONE

OTHER


ASPHALT


BASE


CONCRETE/CEMENT


BRICKS / PAVERS


WASTE


NO INFORMATION

WELL CONSTRUCTION AND PLUGGING MATERIALS


BLANK PIPE


SCREEN


BENTONITE


CEMENT GROUT


BENTONITE & CUTTINGS


CONCRETE/CEMENT


CUTTINGS


GRAVEL


SAND


VOLCLAY

SAMPLE TYPES


AIR ROTARY


GRAB SAMPLE


CORE


GEOPROBE SAMPLER


ROTOSONIC -DAMAGED


MUD ROTARY


NO RECOVERY


NX CORE


PITCHER


ROTOSONIC -INTACT


SHELBY TUBE


SPLIT BARREL


SPLIT SPOON


TEXAS CONE PENETROMETER


DISTURBED

STRENGTH TEST TYPES


POCKET PENETROMETER


TORVANE


UNCONFINED COMPRESSION


TRIAXIAL COMPRESSION UNCONSOLIDATED-UNDRAINED


TRIAXIAL COMPRESSION CONSOLIDATED-UNDRAINED

NOTE: VALUES SYMBOLIZED ON BORING LOGS REPRESENT SHEAR STRENGTHS UNLESS OTHERWISE NOTED

PROJECT NO. ABA18-002-00

RABA KISTNER

REVISED 04/2012

FIGURE 18a

KEY TO TERMS AND SYMBOLS (CONT'D)

TERMINOLOGY

Terms used in this report to describe soils with regard to their consistency or conditions are in general accordance with the discussion presented in Article 45 of SOILS MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc., 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in American Society for Testing and Materials D2487-06 and D2488-00, Volume 04.08, Soil and Rock; Dimension Stone; Geosynthetics; 2005.

The depths shown on the boring logs are not exact, and have been estimated to the nearest half-foot. Depth measurements may be presented in a manner that implies greater precision in depth measurement, i.e 6.71 meters. The reader should understand and interpret this information only within the stated half-foot tolerance on depth measurements.

RELATIVE DENSITY

Penetration Resistance Blows per ft	Relative Density
0 - 4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
> 50	Very Dense

COHESIVE STRENGTH

Resistance Blows per ft	Consistency	Cohesion TSF
0 - 2	Very Soft	0 - 0.125
2 - 4	Soft	0.125 - 0.25
4 - 8	Firm	0.25 - 0.5
8 - 15	Stiff	0.5 - 1.0
15 - 30	Very Stiff	1.0 - 2.0
> 30	Hard	> 2.0

PLASTICITY

Plasticity Index	Degree of Plasticity
0 - 5	None
5 - 10	Low
10 - 20	Moderate
20 - 40	Plastic
> 40	Highly Plastic

ABBREVIATIONS

B = Benzene
T = Toluene
E = Ethylbenzene
X = Total Xylenes
BTEX = Total BTEX
TPH = Total Petroleum Hydrocarbons
ND = Not Detected
NA = Not Analyzed
NR = Not Recorded/No Recovery
OVA = Organic Vapor Analyzer
ppm = Parts Per Million

Qam, Qas, Qal = Quaternary Alluvium
Qat = Low Terrace Deposits
Qbc = Beaumont Formation
Qt = Fluviatile Terrace Deposits
Qao = Seymour Formation
Qle = Leona Formation
Q-Tu = Uvalde Gravel
Ewi = Wilcox Formation
Emi = Midway Group
Mc = Catahoula Formation
El = Laredo Formation
Kknm = Navarro Group and Marlbrook Marl
Kpg = Pecan Gap Chalk
Kau = Austin Chalk

Kef = Eagle Ford Shale
Kbu = Buda Limestone
Kdr = Del Rio Clay
Kft = Fort Terrett Member
Kgt = Georgetown Formation
Kep = Person Formation
Kek = Kainer Formation
Kes = Escondido Formation
Kew = Walnut Formation
Kgr = Glen Rose Formation
Kgru = Upper Glen Rose Formation
Kgrl = Lower Glen Rose Formation
Kh = Hensell Sand

KEY TO TERMS AND SYMBOLS (CONT'D)

TERMINOLOGY

SOIL STRUCTURE

Slickensided	Having planes of weakness that appear slick and glossy.
Fissured	Containing shrinkage or relief cracks, often filled with fine sand or silt; usually more or less vertical.
Pocket	Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting	Inclusion less than 1/8 inch thick extending through the sample.
Seam	Inclusion 1/8 inch to 3 inches thick extending through the sample.
Layer	Inclusion greater than 3 inches thick extending through the sample.
Laminated	Soil sample composed of alternating partings or seams of different soil type.
Interlayered	Soil sample composed of alternating layers of different soil type.
Intermixed	Soil sample composed of pockets of different soil type and layered or laminated structure is not evident.
Calcareous	Having appreciable quantities of carbonate.
Carbonate	Having more than 50% carbonate content.

SAMPLING METHODS

RELATIVELY UNDISTURBED SAMPLING

Cohesive soil samples are to be collected using three-inch thin-walled tubes in general accordance with the Standard Practice for Thin-Walled Tube Sampling of Soils (ASTM D1587) and granular soil samples are to be collected using two-inch split-barrel samplers in general accordance with the Standard Method for Penetration Test and Split-Barrel Sampling of Soils (ASTM D1586). Cohesive soil samples may be extruded on-site when appropriate handling and storage techniques maintain sample integrity and moisture content.

STANDARD PENETRATION TEST (SPT)

A 2-in.-OD, 1-3/8-in.-ID split spoon sampler is driven 1.5 ft into undisturbed soil with a 140-pound hammer free falling 30 in. After the sampler is seated 6 in. into undisturbed soil, the number of blows required to drive the sampler the last 12 in. is the Standard Penetration Resistance or "N" value, which is recorded as blows per foot as described below.

SPLIT-BARREL SAMPLER DRIVING RECORD

Blows Per Foot	Description
25	25 blows drove sampler 12 inches, after initial 6 inches of seating.
50/7"	50 blows drove sampler 7 inches, after initial 6 inches of seating.
Ref/3"	50 blows drove sampler 3 inches during initial 6-inch seating interval.

NOTE: To avoid damage to sampling tools, driving is limited to 50 blows during or after seating interval.

RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Prop. IDEA Robindale School Campus
Southeast Corner of Ruben M. Torres Blvd & Robindale Rd
Brownsville, Cameron County, Texas

FILE NAME: ABA18-002-00.GPJ 2/12/2018

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
B-1	0.0 to 1.5	5	23	85	27	58	CH				
	2.5 to 4.0	13	25						97		
	5.0 to 6.5	7	34	71	28	43	CH				
	7.5 to 9.0	8	33								
	10.0 to 11.5	8	33						61		
	15.0 to 16.5	9	22								
	20.0 to 21.5	4	24								
	23.5 to 25.0	6	26								
B-2	0.0 to 1.5	6	24						93		
	2.5 to 4.0	7	30	82	29	53	CH				
	5.0 to 6.5	9	29						96		
	7.0 to 9.0		32	68	27	41	CH	90		0.65	UC
	10.0 to 11.5	5	32								
	15.0 to 16.5	9	20						67		
	20.0 to 21.5	6	25								
	23.5 to 25.0	4	28								
B-3	0.0 to 1.5	7	25	97	30	67	CH				
	2.5 to 4.0	8	33						98		
	5.0 to 7.0		28	68	25	43	CH			1.70	PP
	7.5 to 9.0	8	33								
	10.0 to 11.5	6	24						92		
	15.0 to 16.5	9	19								
	20.0 to 21.5	5	24								
	23.5 to 25.0	6	19								
B-4	0.0 to 1.5	8	21						94		
	2.5 to 4.0	6	28	75	26	49	CH				
	5.0 to 6.5	6	29						96		
	7.5 to 9.0	9	39	71	27	44	CH				
	10.0 to 11.5	7	30								
	15.0 to 16.5	9	19								
	20.0 to 21.5	12	27								
	23.5 to 25.0	13	27								
B-5	0.0 to 1.5	5	31	90	33	57	CH				
	2.5 to 4.0	6	26						95		
	5.0 to 6.5	7	36	72	30	42	CH				
	7.5 to 9.0	7	32								
	10.0 to 11.5	9	22						92		
	15.0 to 16.5	8	19								
	20.0 to 21.5	7	18								

PP = Pocket Penetrometer TV = Torvane UC = Unconfined Compression FV = Field Vane UU = Unconsolidated Undrained Triaxial

CU = Consolidated Undrained Triaxial CNBD = Cound Not Be Determined NP = Non-Plastic

RESULTS OF SOIL SAMPLE ANALYSES

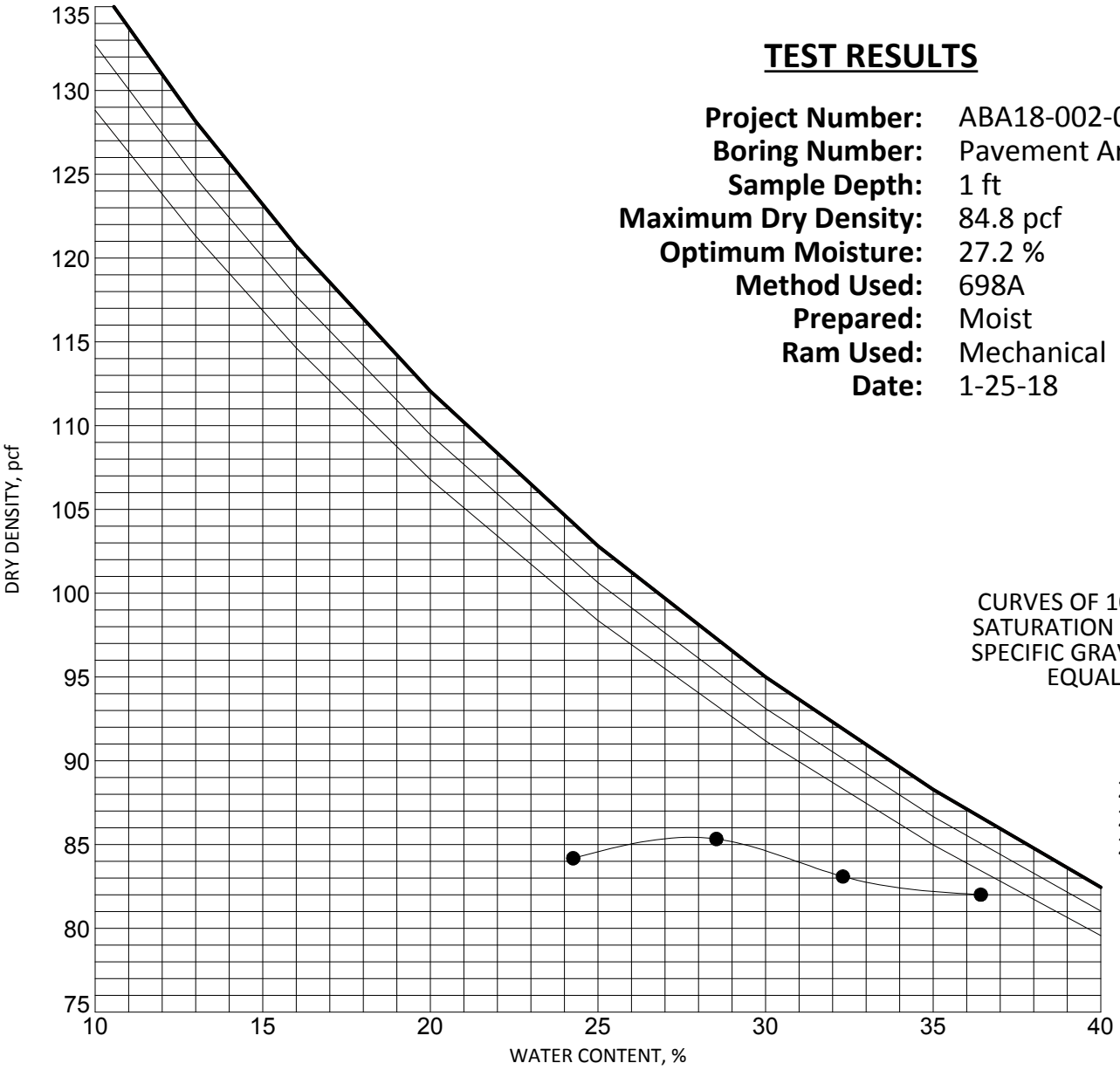
PROJECT NAME: Prop. IDEA Robindale School Campus
Southeast Corner of Ruben M. Torres Blvd & Robindale Rd
Brownsville, Cameron County, Texas

FILE NAME: ABA18-002-00.GPJ 2/12/2018

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
B-5	23.5 to 25.0	5	17								
B-6	0.0 to 1.5	5	23						91		
	2.0 to 4.0		30	65	26	39	CH	92		0.97	UC
	5.0 to 6.5	10	34								
	7.5 to 9.0	8	31	74	27	47	CH				
	10.0 to 11.5	7	32						66		
	15.0 to 16.5	9	19								
	20.0 to 21.5	6	24								
	23.5 to 25.0	8	26								
P-1	0.0 to 1.5	8	32	80	31	49	CH				
	3.5 to 5.0	6	35								
P-2	0.0 to 1.5	9	22	90	28	62	CH				
	3.5 to 5.0	11	26								
P-3	0.0 to 1.5	8	31								
	3.5 to 5.0	7	24	81	29	52	CH				
P-4	0.0 to 1.5	8	24	96	32	64	CH				
	3.5 to 5.0	8	32								
P-5	0.0 to 1.5	6	25	88	30	58	CH				
	3.5 to 5.0	8	31								
P-6	0.0 to 1.5	8	32				CH				
	3.5 to 5.0	10	30	92	28	64					
P-7	0.6 to 2.1	9	30								
	3.5 to 5.0	8	36	79	30	49	CH				
P-8	0.8 to 2.3	8	30	80	28	52	CH				
	3.5 to 5.0	9	36								
P-9	0.8 to 2.3	8	29	82	33	49	CH				
	3.5 to 5.0	8	33								
P-10	0.8 to 2.3	7	34	84	30	54	CH				
	3.5 to 5.0	7	34								

PP = Pocket Penetrometer TV = Torvane UC = Unconfined Compression FV = Field Vane UU = Unconsolidated Undrained Triaxial

CU = Consolidated Undrained Triaxial CNBD = Cound Not Be Determined NP = Non-Plastic



TEST RESULTS

Project Number:	ABA18-002-00
Boring Number:	Pavement Areas
Sample Depth:	1 ft
Maximum Dry Density:	84.8 pcf
Optimum Moisture:	27.2 %
Method Used:	698A
Prepared:	Moist
Ram Used:	Mechanical
Date:	1-25-18

CBR (California Bearing Ratio) of Laboratory-Compacted Soils (ASTM D 1889):

CBR:	2.5
% Swell:	2.2

Remolded at 119.7% of the maximum dry density determined above.

Soil Type:

Borrow Source Description:	Pavement Areas Not Provided
Classification (ASTM D 2488):	Fat Clay (CH)
Classification (Visual):	Fat Clay

LL = 85; PL = 27; PI = 58

FIGURE 20

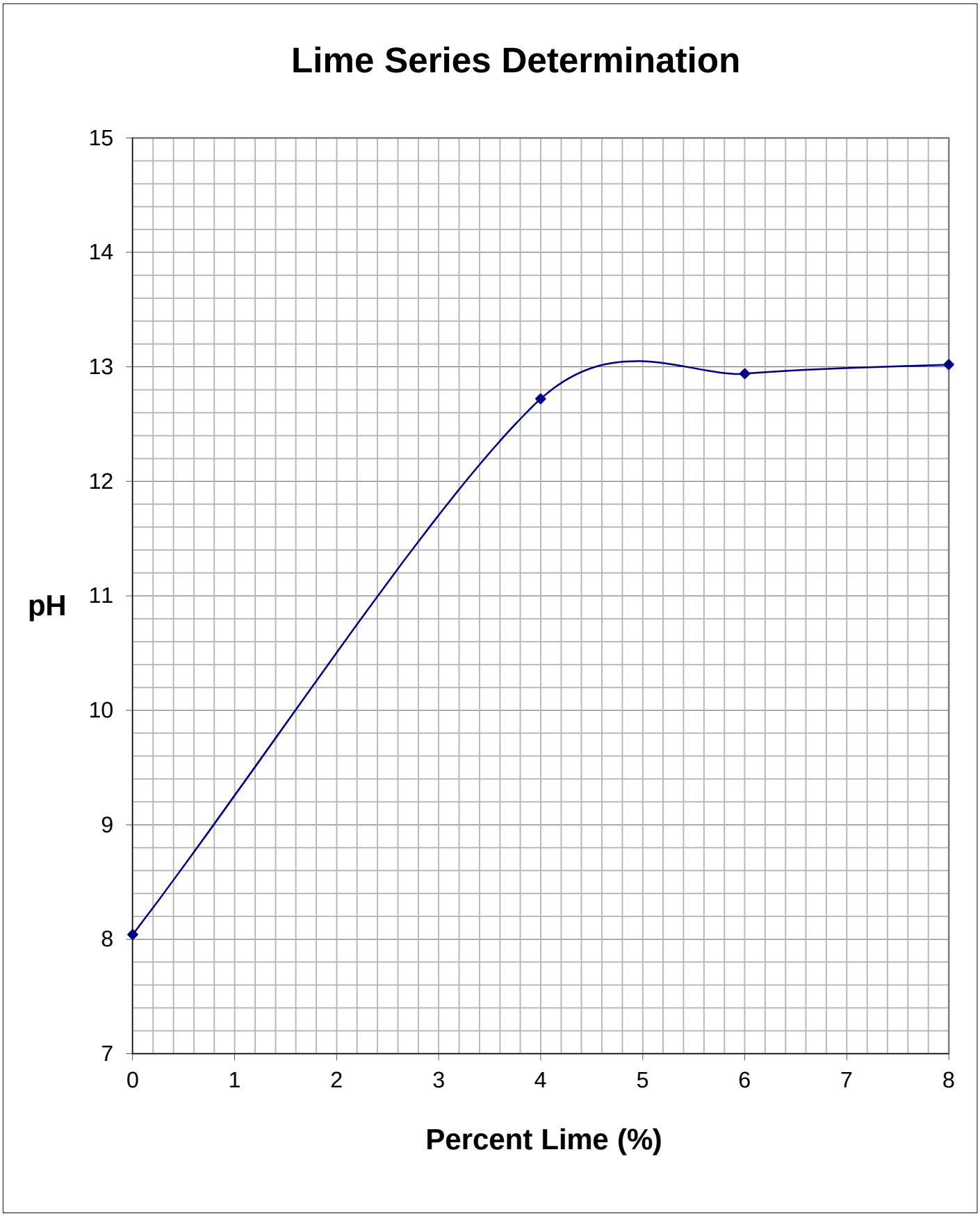
MOISTURE-DENSITY RELATIONSHIP

Prop. IDEA Robindale School Campus
Southeast Corner of Ruben M. Torres Blvd
& Robindale Rd
Brownsville, Cameron County, Texas

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TBPE Firm Registration No. F-3257

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(956) 682-5487 fax
www.rkci.com

R-K COMPACTION & CBR ABA18-002-00.GPJ RKCI.GDT 2/12/18



Project No. ABA18-002-00

Figure 21

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

GEOTECHNICAL BUSINESS COUNCIL
of the Geoprofessional Business Association

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@geoprofessional.org www.geoprofessional.org

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CONSULTANTS • ENVIRONMENTAL • FACILITIES • INFRASTRUCTURE

San Antonio, TX

Austin, TX	Dallas , TX	McAllen, TX
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Corpus Christi , TX	Houston, TX	Salt Lake City, UT

GREEN, RUBIANO & ASSOCIATES

Structural Engineers
Firm Registration #: F-4145

1220 West Harrison
Harlingen, Texas 78550
(956) 428-4461
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Project Memorandum

Date: May 9, 2018

To: David Monreal, A.I.A.
GMS Architects
Brownsville, TX

GRA Project#: 192- 509 Idea Public Schools Robindale Campus Phase I

Re: Roof Components, Exterior Claddings & Fenestrations Design Wind Pressures

Below are the design wind pressures for roof components, exterior wall claddings and fenestration assemblies for the buildings at the referenced project. Please make reference to these design wind pressures, and the associated roof diagrams illustrated on our drawings, in your specifications and contract documents for roofing, masonry veneer, EIFS and stucco cladding, curtain wall/storefront windows and doors, window shade canopies, hollow metal doors, louvers and exterior wall mounted components, and any other roof or exterior wall cladding or fenestration assembly included on this project. In addition, all exterior glazed openings and louver assemblies must be impact resistant per ASTM E 1886 & E 1996 (or glazing shall be protected by an impact resistant covering).

The roof components, exterior claddings and fenestration assemblies, and anchoring of these items to the structure shall be tested per the building code requirements to meet the following design wind pressures:

Roofing System & Roof Components			Doors, Windows & Curtain Walls	
Zone 1	Zone 2	Zone 3	P+ (towards the surface)	P- (away from the surface)
-42 psf	-70 psf	-104 psf	+38 psf	-51 psf

Roof top mechanical equipment and their support components (curbs, stands, sleepers, etc.), and anchoring of these items to the structure, shall be specified as a delegated design to be performed by the equipment's manufacturer, to meet the greater wind pressures calculated using the following design standards and parameters:

ASCE 7-10 Section 29.5.1		ASCE 7-05 Section 6.5.15.1	
Ultimate Design Wind Speed	153 mph	Nominal Design Wind Speed	120 mph
Risk Category	III	Importance Factor	1.15
Exposure Category	C	Exposure Category	C

We appreciate the opportunity to assist you with this project. Please feel free to contact us if you have any questions.

Sincerely,



Rolando R. Rubiano, P.E.

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01010 - SUMMARY OF WORK:

1.1 Location: The project site for IDEA Brownsville Robindale Phase I is the SE Corner at Robindale Rd. and FM 802, Brownsville Texas

1.2 Approval of Working Surfaces: Any contractor performing work over the work of other contractors shall notify the Architect of any unsatisfactory condition. Beginning of work by any contractor shall constitute the acceptance of the previous work.

1.3 Checking Dimensions at Site: Before ordering any materials or doing any work, verify all measurements of the building and be responsible for the correctness of them. No extras will be allowed for variations from drawings in existing conditions or for work performed under this contract. Any discrepancies found shall be submitted to the Architect for instruction before proceeding. The Section shall be enforced diligently.

1.4 Cutting & Patching: No excessive cutting will be permitted, nor shall any structural members be cut without the approval of the Architect. Each contractor shall leave all chases and openings straight, true and of the proper size in his work as may be necessary for the proper installation of his and/or other contractor's work. After such work has been installed, he shall carefully fit around, close up, repair, patch and point up same as directed, to the entire satisfaction of the Architect.

1.5 Cooperation: The General Contractor, all other contractors and all sub-contractors shall coordinate their work with all adjacent work and shall cooperate with all other trades so as to facilitate the general progress of the work. Each trade shall afford all other trades every reasonable opportunity for installation of their work and storage of their materials.

1.6 Project Logbook: The project superintendent shall maintain a daily project logbook, indicating which sub-contractors were on the job, time of arrival, and the number of workers. Statements as to the daily progress shall be logged. This log book shall be made available to the Architect and shall be kept at the job site office.

1.7 Inspection and Tests: Architect and his representative shall at all times have access to the work whether it is in preparation or progress. Provide proper and safe facilities for such access and inspection. Make all inspections and test in connection with this entire contract as required by the Architect. All material testing shall be paid for by the Owner.

1.8 Security: Provide security fencing in all work areas. See Temporary Facilities.

1.9 Mock up Panel: Provide a mock-up for evaluation of product and application workmanship.

1. Install in area and of size designated by Architect.
    a. Construct mockup to illustrate backup wall, exterior sheathing, air barrier, cavity wall, connectors, weep holes, cavity vents, and through wall flashing.
    b. Construct mockup panel 72 inches by 72 inches to illustrate coursing, anchorage, mortar joints and color, window opening and flashing system.

2. Do not proceed with work until finish color, texture, pattern, joint sizes, and installation workmanship are approved by Architect.
3. Correct mock-up area as required to produce acceptable work.

2. ALLOWANCES:
See Paragraph 4.8 of the General Conditions.

2.1 Betterment Allowance: Include the sum set forth below as a Betterment Allowance which will, if needed, be expended on Betterment to the Project, as directed in writing by approved change orders;

BETTERMENT ALLOWANCE: $ 300,000.00

2.2 Structural Allowance:

Reinforcing Bars = 3.0 tons @ $2,000 per ton M&L (Refer to Spec Section 03200 and Sheet S1.1 General Structural Notes, Concrete Note 12)

Fabricated / Primed Steel = 3.0 tons @ $4,000 per ton M&L (Refer to Spec Section 05120 and Sheet S1.1 General Structural Notes, Structural Steel Note 17)

SECTION 0110 - BID SCHEDULE
1. BID SCHEDULE: All proposals and alternate bid items shall be subject to the General and Special Conditions and all other related sections of the specifications and requirements of the drawings. The Owner shall have the right to accept or reject any or all alternates.

1.1 BASE BID: The Contractor shall state on the General Contract Bid Proposal under the Base Bid, the amount for all work, complete in all respects in accordance with plans and specifications, to construct Brownsville Robindale Phase I. The scope of work is defined in the plans and specifications.

1.2 ALTERNATES: The Contractor shall state on his Bid Form, under each Alternate the amount to add to his bid to perform all work, complete in all respects, in accordance with the plans and specifications to construct work required by the Alternates.

Alternate #1: Provide Domestic Water Booster Pumps as indicated on Plumbing Drawings

1.3 KITCHEN EQUIPMENT COST: The Contractor shall state on the General Contract Bid Proposal under the Kitchen Equipment Cost, a lump sum amount for ALL Kitchen Equipment as listed in Specification Section **11400 Food Service Equipment**; kitchen walk-ins as listed in Specification Section **11410 Walk-In Cooler/Freezer**; and kitchen hood as listed in Specification **233813 Commercial Kitchen Hoods**. Lump sum cost should include delivery, installation and contractor mark-up. DO NOT include plumbing, electrical or mechanical rough-in to equipment. (This break-out cost should already be included in BASE BID.)

SECTION 0120 - AS BUILT DRAWINGS:
As the work proceeds, keep careful records of piping, electrical circuits, duct work and other concealed work whose installed location varies from that shown on plans. Furnish the Architect with one marked up set before final.

SECTION 0130 - REPORTS:
The Contractor will provide a written report to the Architect after each inspection conducted by the City Inspectors concerning their findings.

SECTION 0140 - QUANTITIES & WARRANTIES:
All guarantees and warranties expressed or implied shall be provided to the Architect in written form prior to final payment.

SECTION 0150 - PICTURES:
The Contractor will provide the Architect with sequence photographs showing the flashing in place prior to installation of exterior windows, doors and application of roofing material. This is MANDATORY. Close-ups of ALL flashing are required.

The Contractor is required to submit progress photos with each month's application for payment.

The Contractor is required to provide Aerial Photos (North, South, West, and East) monthly and submit with each month's application for payment until the project is substantially complete.

SECTION 0160 - CERTIFICATION OF CONSTRUCTION:
The building contractor or construction manager shall certify in writing that the facility has been constructed in accordance to the construction documents and its specifications.

SECTION 0170 - CERTIFICATION OF NON-USE OF ASBESTOS PRODUCTS
The General Contractor shall provide the Architect with written certification letters from all sub-contractors and suppliers that no asbestos products shall be used on this project.

SECTION 0180 - SCOPE AND SEQUENCE OF CONSTRUCTION
1.1 General:
This building must be completed by **June 1, 2019**. Time extensions shall be submitted for review on a monthly basis.

The successful bidder shall under no circumstances leave this project unsecured or unprotected at any time during construction. The General Contractor is to refer to Section 01505 Temporary Facilities for any and all requirements required by this project.

The General Contractor to provide all necessary precautions and safeguards during construction for protection of any visitor whom might visit the project site. The General Contractor shall provide in a neat format project monthly reports with photos showing progress of construction for their review.

SECTION 01300 – ADMINISTRATIVE REQUIREMENTS

Electronic Submittal Procedures

A. Summary:
   1. Shop drawing and product data submittals shall be transmitted to Architect in electronic (PDF) format using a website service designed specifically for transmitting submittals between construction team members.
   2. The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.
   3. The electronic submittal process is not intended for color samples, color charts, or physical material samples.
   4. Providers: Submittal Exchange; Owner InSite; Procore; Viewpoint, etc.

B. Procedures:
   1. Electronic submittal preparation - Contractor may use any or all of the following options:
      a. Subcontractors and Suppliers provide electronic (PDF) submittals to Contractor via the electronic submittal website.
      b. Subcontractors and Suppliers provide paper submittals to General Contractor who electronically scans and converts to PDF format.
      c. Subcontractors and Suppliers provide paper submittals to Scanning Service which electronically scans and converts to PDF format.
   2. Contractor shall review and apply electronic stamp certifying that the electronic submittal complies with the requirements of the Contract Documents including verification of manufacturer / product, dimensions and coordination of information with other parts of the work.
   3. Contractor shall transmit each electronic submittal to Architect using the electronic submittal website.
   4. Architect / Engineer review comments will be made available on the electronic submittal website for downloading. Contractor will receive email notice of completed review.
   5. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of the Contractor.

C. Costs:
   1. General Contractor shall include the full cost of electronic submittal project subscription in their proposal. This cost is included in the Contract Amount. Contact electronic submittal service provider to verify cost prior to bid.
   2. At Contractor's option, training is available from electronic submittal service. regarding use of website and PDF submittals.
   3. Internet Service and Equipment Requirements:
      a. Email address and Internet access at Contractor's main office.
      b. Adobe Acrobat (www.adobe.com), Bluebeam PDF Revu (www.bluebeam.com), or other similar PDF review software for applying electronic stamps and comments.

SECTION 01340 - SUBMITTALS

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specifications, apply to work of this section.

DESCRIPTION OF REQUIREMENTS:
The types of submittal requirements for specified in this section including shop drawings, product data, samples and miscellaneous work related Submittals. Individual submittal requirements are specified in applicable sections for each unit of work. Refer to other Division 1 sections and other contract documents for requirements of administrative Submittals.

Definitions: Work related Submittals of this section are categorized for convenience as follows:

Shop drawings include specially prepared technical data for this project including drawings, diagrams; performance curves data sheets schedules, templates, patterns, reports, calculations, instructions, measurements and similar information not in standard printed form for general application to a range of similar projects.

Product data includes standard printed information on manufactured products that has not been specially prepared for this project, other than the designation of selections from among available choices printed therein.

Samples include both fabricated and un-fabricated physical examples of materials, products and units of work; both as complete units and as smaller portions of units of work; either for limited visual inspection or (where indicated) for more detailed testing and analysis.

Mock ups are special forms of samples, which are too large or otherwise inconvenient for handling in the manner specified for transmittal of sample Submittals.

Miscellaneous Submittals related directly to the work (non administrative) include warranties, maintenance agreements, workmanship bonds, project photographs, survey data and reports, physical work records quality testing and certification reports, copies of industry standards, record drawings, field measurement data, operating and maintenance manuals, overrun stock, and similar information, devices and materials applicable to the work and not processed as shop drawings, product data or samples.

GENERAL SUBMITTAL REQUIREMENTS:

Scheduling: Where appropriate in administrative submittals, (listing of products, manufacturers, suppliers and sub-contractors, and in job progress schedule), show principal work related submittals and time requirements for coordination of submittal activity with related work in each instance.

Listing: Prepare a separate listing; organized by related specification section number sequence, showing principal work related submittals and their initial submittal dates as required for coordination of the work. Submit listing within 45 days of date of commencement of the work.

Coordination and Sequencing: Coordinate preparation and processing of submittals with the performance of the work so that work will not be delayed by submittals. Coordinate and sequence different categories of submittals for same work, and for interfacing units of work, so that one will not be delayed for coordination of A/E's review with another.

Preparation of Submittals: Provide permanent marking on each submittal to identify project, date, Contractor, subcontractor, Submittal name, and similar information to distinguish it from other submittals. Show Contractor’s executed review and approval markings and provide space for the Architect/Engineer's "Action" marking. Package each submittal appropriately for transmittal and handling. Submittals which are received from sources other than through Contractor's office will be returned by A/E "without action".

SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS:

General: Except as otherwise indicated in the individual work sections, comply with the requirements specified herein for each indicated category of submittal. Provide and process intermediate submittals, where required between initial and final, similar to initial submittals.

Shop Drawings: Provide newly prepared information, on reproducible sheets, with graphic information at accurate scale (except as otherwise indicated), with name of preparer indicated (firm name). Show dimensions and not which are based on field measurement. Identify materials and products in the work shown. Indicate compliance with standards and special coordination requirements. Do not allow shop drawing copies without appropriate final "Action” markings by the Architect/Engineer to be used in connection with the work.

Initial Submittal: Provide one electronic print with requested testing data, ICC-ES reports and TDI reports, where applicable.

Product Data: Collect required data into one submittal for each unit of work or system; and mark each copy to show which choices and options are applicable to project. Include manufacturer's standard printed recommendations for application and use, compliance with standards, application of labels and seals, notation of field measurements which have been checked, and special coordination requirements. Maintain one set of product data (for each submittal) at project site, available for reference by Architect/Engineer and others.

Submittals: Do not submit product data, or allow its use on the project, until compliance with requirements of contract documents has been confirmed by Contractor. Submittal is for information and record, unless otherwise indicated.

Initial submittal is final submittal unless returned promptly by Architect/Engineer, marked with an "Action” which indicates an observed non-compliance. Submit 3 copies where required for maintenance manuals.

Samples: Provide units identical with final condition of proposed materials or products for

the work. Include "range" samples (not less than 3 units) where unavoidable variations must be expected, and described or identify variations between units of each set. Provide full set of optional samples where Architect's/Engineer's selection is required. Prepare samples to match Architect's/Engineer's sample where so indicated. Include information with each sample to show generic description, source or product name and manufacturer, limitations, and compliance with standards. Samples are submitted for review and confirmation of color, pattern, texture and "kind" by Architect/Engineer. Architect/Engineer will not "test" samples (except as otherwise indicated) for compliance with other requirements, which are therefore the exclusive responsibility of Contractor.

Submittal: Provide a single set of samples for Architect's/Engineer's review and "Action".

Mock Ups and similar samples specified in individual work sections recognized as a special type of sample. Comply with requirements for "samples" to greatest extent possible, and process transmittal forms to provide a record of activity.

Inspection and Test Reports: Classify each as either "shop drawings" or "product data" depending upon whether report is uniquely prepared for project, or a standard publication of workmanship control testing at point of production and process accordingly.

Warranties: Refer to "Products" section for specific general requirements on warranties, product/workmanship bonds and maintenance agreements. In addition to copies desired for the Contractor's use, furnish 2 executed copies except furnish 2 additional (conformed) copies where required for maintenance manuals.

Closeout Submittals: Refer to Section 01705 Project Closeouts and to individual work sections for specific requirements on submittal of closeout information, materials, tools, and similar items.

Materials and Tools: Refer to individual work sections of for required quantities of spare parts, extra and overrun stock, maintenance tools and devices, keys, and similar physical units to be submitted.

General Distribution: Provide additional distribution of submittals (not included in foregoing copy submittal requirements) to subcontractors, suppliers, fabricators, installers, governing authorities, and others as necessary for the proper performance of the work. Include such additional copies in transmittal to the Architect/Engineer where the submittals are required to receive "Action" marking before final distribution. Record submittal distributions on transmittal forms.

ACTION ON SUBMITTALS

Architect/Engineer's Action: Where action and return is required or requested, the Architect/Engineer will review each submittal, mark with “Action", and where possible return within 2 weeks of receipt.

Where the submittal must be held for coordination, Contractor will be so advised by A/E without delay.

Final Unrestricted Release: Work may proceed, provided it complies with the contract

documents, when submittal is returned with the following:

Marking: "Accepted".
Marking: "Reviewed".

Final But Restricted Release: Work may proceed, provided it complies with notations and corrections on submittal and with contract documents, when submittal is returned with the following:

Marking: "Accepted as Noted".
Marking: "Reviewed as Noted".

Returned for Resubmittal: Do not proceed with work. Revise submittal in accordance with notations thereon, and resubmit without delay to obtain a different action marking. Do not allow submittals with the following marking (or unmarked submittals where a marking is required) to be used in connection with performance of the work:

Marking: "Not Accepted, Resubmit".
Marking: "Revise and Resubmit".

Other Action: Where the submittal is returned, for other reasons, with Architect/Engineer's explanation included, it will be marked as follows:

Marking: "Action Not Required".
Marking: "No Action".

Action Stamp: Architect's/Engineer's action stamp, for use on submittals to be returned to Contractor, is self explanatory as marked.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION (Not Applicable).

END OF SECTION 01340

SECTION 01505 - -TEMPORARY FACILITIES

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification sections, apply to the work of this section.

DESCRIPTION OF REQUIREMENTS:

Definitions: Specific administrative and procedural minimum actions are specified in this section, as extensions of provisions in General Conditions and other contract documents. These requirements have been included for special purposes as indicated. Nothing in this section is intended to limit types and amounts of temporary work required, and no omission from this section will be recognized as an indication by Architect or Engineer that such temporary activity is not required for successful completion of the work and compliance with requirements of contract documents. Provisions of this section are applicable to, but not by way of limitation, utility services, construction facilities, support facilities, security/protection provisions, and support facilities.

QUALITY ASSURANCE:

General: In addition to compliance with governing regulations and rules/recommendation of franchised utility companies, comply with specific requirements indicated and with applicable local industry standards for construction work (published recommendations by local consensus "building councils").

ANSI Standards: Comply with applicable provisions of ANSI Al Series standards on construction safety, including A.10.3, A.10.4, A10.5, A10.6, A10.7, A10.8, A10.9, A10.10, A10.11, A10.12, A10.13, A10.14, A10.15, A10.17, A10.18, A10.20, and A10.22.

NFPA Code" Comply with NFPA Code 241 "Building Construction and Demolition Operations."

JOB CONDITIONS:

General: Establish and initiate use of each temporary facility at time first reasonably required for proper performance of the work. Terminate use and remove facilities at earliest reasonable time, when no longer needed or when permanent facilities have, with authorized use, replaced the need.

Conditions of Use: Install, operate, maintain and protect temporary facilities in a manner and at locations which will be safe, non hazardous, sanitary and protective of persons and property, and free of deleterious effects.

PART 2 AND 3 - PRODUCTS AND EXECUTION

TEMPORARY UTILITY SERVICES:

The types of services required include, but not by way of limitation, water, sewerage, surface drainage, electrical power and telephones. Where possible and reasonable, connect to existing franchised utilities for required services; and comply with service

companies' recommendations on materials and methods, or engage service companies to install services. Locate and relocate services (as necessary) to minimize interference with construction operations.

TEMPORARY CONSTRUCTION FACILITIES:

The types of temporary construction facilities required include, but not by way of limitation, water distribution, drainage, enclosure of work, heat, ventilation, electrical power distribution, lighting, hoisting facilities, stairs, ladders, and roads. Provide facilities reasonably required to perform construction operations properly and be large enough to accommodate meetings for 10 persons.

Water Distribution: Provide hose lengths sufficient to reach entire area of construction work, not less than 3/4" hose size. Prevent freezing of water distribution by either prompt drainage after each use, or by suitable protection.

Electrical Power: Provide weatherproof, grounded, power distribution system sufficient to accommodate construction operations requiring power, use of power tools, electrical heating, lighting, and start up testing of permanent electric powered equipment prior to its permanent connection to electrical system. Provide overload protection. Locate multiple outlets (not less than 4 gang boxes) at each story of construction, spaced so that entire area of construction can be reached by power tools on a single extension cord of 100' maximum length.

> Supply power for electric welding, if any, from either temporary power distribution system or by engine driven power generator sets, at Contractor's option.

Lighting: Provide sufficient temporary lighting to ensure proper workmanship everywhere; by combined use of daylight, general lighting, and portable plug in task lighting. Provide general lighting with local switching which will enable energy conservation during periods of varying activity (work in progress, traffic only security check, lock up, etc.).

> Provide uniformly spaced general lighting equivalent to not less than one 200 watt incandescent lamp per 1000 sq. ft. of floor area, and one 100 watt lamp per 50' of corridor and per flight of stairs.

Access Provisions: Provide ramps, stairs, ladders and similar temporary access elements as reasonably required to perform the work and facilitate its inspection during installation. Comply with reasonable requests of governing authorities performing inspections. When permanent stairs are available for access during construction, cover finished surfaces with sufficient protection to ensure freedom from damage and deterioration at time of substantial completion.

SECURITY/PROTECTION PROVISION:

The types of temporary security and protection provision required include, but not by way of limitation, fire protection, barricades, fencing (wire), warning signs/lights, and similar provision intended to minimize property losses, personal injuries and claims for damages at project site.

Fire Extinguishers: Provide types, sizes, numbers and locations as would be reasonably effective in extinguishing fires during early stages, by personnel at project site. Provide Type A extinguishers at locations of low potential for either electrical or grease oil

flammable liquids fires; provide Type ABC dry chemical extinguishers at other locations; comply with recommendations of NFPA No. 10. Post warning and quick instructions at each extinguisher location, and instruct proper use of extinguishers and other available facilities at project site. Post local fire department call number on each telephone instrument at project site.

Permanent Fire Protection: Complete each fire protection facility at earliest reasonable date, make ready for emergency use, and instruct personnel at site on availability and proper use.

Building Enclosure and Lockup: At earliest possible date, secure building against unauthorized entrance at times when personnel are not working.

Temporary Fencing is required at all work areas (Building Addition, walk-way canopies, soccer field, new parking areas etc.) to provide protection for building occupants using the portion of the building being used. Coordinate locations with Owner.

TEMPORARY SUPPORT FACILITIES:

The types of temporary support facilities required include, but not by way of limitation, field offices, storage sheds, fabrication sheds, sanitary facilities, drinking water, first aid facilities, bulletin board, private telephones, project identification signs, clean up facilities, waste disposal service, and similar miscellaneous general services, all as may be reasonably required for proficient performance of the work and accommodation of personnel at the site including Owner's and Architect's/Engineer's personnel.

Discontinue and remove temporary support facilities, and make incidental similar use of permanent work of the project, only when and in manner authorized by Architect/Engineer; and, if not otherwise indicated, immediately before time of substantial completion. Locate temporary support facilities for convenience of users, and for minimum interference with construction activities.

Contractor's Field Offices: Provide adequate office space for field office personnel plus one spare work station for incidental use by subcontractor's personnel, suitably finished, furnished, equipped and conditioned.

Sanitary Facilities: At contractor's option, provide either piped (wet) toilets facilities or self contained toilet units of type acceptable to governing authorities, adequate (at all stages of construction) for use of personnel at job site. Provide separate facilities for male and female personnel when both sexes are working (in any capacity) at project site.

Project Identification Sign: At locations(s) shown on site plans provide project identification sign complying with sketch/data sheet included at end of this section. Engage an experienced sign painter to paint graphics on sign as indicated. Construct sign of treated wood framing and posts, and 3/4" plywood panels of exterior type Grade B C sanded 2 sides.

END OF SECTION 01505

SECTION 01605 - PRODUCTS AND SUBSTITUTIONS

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF REQUIREMENTS:

Definitions: "Products" is defined to include purchased items for incorporation into the work, regardless of whether specifically purchased for project or taken from Contractor's stock of previously purchased products. "Materials", is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined or otherwise fabricated, processed, installed or applied to form units of work. "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, etc.). Definitions in this paragraph are not intended to negate the meaning of other terms used in contract documents, including "specialties," "systems," "structure," "finishes," "accessories," "furnishings," "special construction," and similar terms, which are self explanatory and have recognized meanings in the construction industry.

Substitutions: The requirements for substitutions do not apply to specified Contractor options on products and construction methods. Revisions to contract documents, where requested by Owner, Architect or Engineer, are "changes" not "substitutions." Substitutions requested during bidding period, which have been accepted prior to Contract Date, are included in contract documents and are not subject to requirements for substitutions as specified herein. Contractor's determination of an compliance with governing regulations and orders issued by governing authorities do not constitute "substitutions;" and do not constitute a basis for change orders, except as provided for in contract documents. Otherwise, Contractor's requests for changes in products, materials and methods of construction required by contract documents after the bidding period are considered requests for "substitutions," and are subject to requirements hereof.

Standards: Refer to Division 1 section "Definitions and Standards" for applicability of industry standards to products of project, and for acronyms used in text of specification sections.

QUALITY ASSURANCE:

Source Limitations: To the greatest extent possible, for each unit of work, provide products, materials or equipment of a singular generic kind and from a single source.

Compatibility of Options: Where more than one choice is available as options for Contractor's selection of a product or material, select an option which is compatible with other products and materials already selected (which may have been from among options for those other products and materials). Total compatibility among options is not assured by limitations within contract documents, but must be provided by Contractor. Compatibility is a basic general requirement of product/material selections.

SUBMITTALS:

Requests for Substitutions: Submit 3 copies, fully identified for product or method being replaced by substitution, including related specification section and drawing number(s), and fully documented to show compliance with requirements for substitutions. Include product data/drawings, description of methods, samples where applicable, Contractor's detailed comparison of significant qualities between specified item and proposed substitution, statement of effect on construction time and coordination with other affected work, cost information or proposal, and Contractor's statement to the effect that proposed substitution will result in overall work equal to or better than work originally indicated.

PRODUCT DELIVER STORAGE HANDLING:

General: Deliver, handle and store products in accordance with manufacturer's recommendations and by methods and means which will prevent damage, deterioration, and loss including theft. Control delivery schedules to minimize long term storage of products at site and overcrowding of construction spaces. In particular, provide delivery/installation coordination to ensure minimum holding or storage times for products recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other sources of loss.

WARRANTIES (GUARANTEES):

Categories of Specific Warranties: Warranties on the work are in several categories, including those of General Conditions, and including (but not necessarily limited to) the following specific categories related to individual units of work specified in sections of Divisions 2 through 16 of these specifications:

Special Project Warranty (Guarantee): A warranty specifically written and signed by Contractor for a defined portion of the work; and, where required, countersigned by subcontractor, installer, manufacturer or other entity engaged by Contractor.

Specified Product Warranty: A warranty which is required by contract documents, to be provided for a manufactured product incorporated into the work; regardless of whether manufacturer has published a similar warranty without regard for specific incorporation of a product into the work, or has written and executed a special product warranty as a direct result of contract document requirements.

Coincidental Product Warranty: A warranty which is not specifically required by contract documents (other than as specified in this Section); but which is available on a product incorporated into the work, by virtue of the fact that manufacturer of product has published warranty in connection with purchases and uses of product without regard for specific applications except as otherwise limited by terms of warranty.

Refer to individual sections of Divisions 2 through 16 for the determination of units of work which are required to be specifically or individually warranted, and for the specific requirements and terms of those warranties (or guarantees).

General Limitations: It is recognized that specific warranties are intended primarily to protect Owner against failure of the work to perform as required, and against deficient, defective and faulty materials and workmanship, regardless of sources. Except as otherwise indicated, specific warranties do not cover failures in the work which result from: 1.) Unusual and abnormal phenomena of the elements, 2.) The Owner's misuse,

maltreatment or improper maintenance of the work, 3.) Vandalism after time of substantial completion, or 4.) Insurrection or acts of aggression including war.

Related Damages and Losses: In connection with Contractor's correction of warranted work which has failed, remove and replace other work of project which has been damaged as a result of such failure, or must be removed and replaced to provide access for correction of warranted work.

Consequential Damages: Except as otherwise indicated or required by governing regulation, special project warranties and product warranties are not extended to cover damage to building contents (other than work of Contract) which occurs as a result of failure of warranted work.

Reinstatement of Warranty Period: Except as otherwise indicated, when work covered by a special project warranty or product warranty has failed and has been corrected by replacement or restoration, reinstate warranty by written endorsement for the following time period, starting on date of acceptance of replaced or restored work.

A period of time is equal to original warranty period of time.

Replacement Cost, Obligations: Except as otherwise indicated, costs of replacing or restoring failing warranted units or products is Contractor's obligation, without regard for whether Owner has already benefited from use through a portion of anticipated useful service lives.

Rejection of Warranties: Owner reserves the right, at time of substantial completion or thereafter, to reject coincidental product warranties submitted by Contractor, which in opinion of Owner tend to detract from or confuse interpretation of requirements of contract documents.

Contractor's Procurement Obligations: Do not purchase, subcontract for, or allow others to purchase or sub subcontract for materials or units of work for materials or units of work for project where a special project warranty, specified product warranty, certification or similar commitment is required, until it has been determined that entities required to countersign such commitments are willing to do so.

Specific Warranty Forms: Where a special project warranty (guarantee) or specified project warranty is required, prepare a written document to contain terms and appropriate identification, ready for execution by required parties. Submit draft to Owner (through Architect/Engineer) for approval prior to final executions.

PART 2 PRODUCTS

GENERAL PRODUCT COMPLIANCES:

General: The compliance requirements, for individual products as indicated in contract documents, are multiple in nature and may include generic, descriptive, proprietary, performance, prescriptive, compliance with standards, compliance with codes, conformance with graphic details and other similar forms and methods of indicating requirements, all of which must be complied with. Also "allowances" and similar provisions of contract documents will have a bearing on selection process.

Procedures for Selecting Products: Contractor's options for selecting products are limited by contract document requirements, and governing regulations, and are not controlled by industry and governing regulations, and are not controlled by industry traditions or procedures experienced by Contractor on previous construction projects.

Required procedures include, but are not necessarily limited to, the following for various indicated methods of specifying:

Single Product/Manufacturer Name: Provide product indicated, except advice Architect/Engineer before proceeding, where known that named product is not a feasible or acceptable selection.

Two or More Product/Manufacturer Names: Provide one of the named products, at Contractor's option; but excluding products which do not comply with requirements. Do not provide or offer to provide an unnamed product, except where none of named products comply with requirements or are a feasible selection; advise Architect/Engineer before proceeding.

"Or Equal": Where named products in specifications text are accompanied by the term "or equal", or other language of similar effect, comply with those contract document provisions concerning "substitutions" for obtaining Architect/Engineer's approval (by change order) to provide an unnamed product. This product must meet or exceed the original specified product specifications.
"Named", except as otherwise indicated, is defined to mean manufacturer's name for product, as recorded in published product literature, of latest issue as of date of contract documents. Refer requests to use products of a later (or earlier) model to Architect/Engineer's for acceptance before proceeding.

Standards, Codes and Regulations: Where only compliance with an imposed standard, code or regulation is required, selection from among products which comply with requirements including those standards, codes and regulations, is Contractor's option.

Performance Requirements: Provide products which comply with specific performances indicated, and which are recommended by manufacturer (in published product literature or by individual certification) for application indicated. Overall performance of a product is implied where product is specified with only certain specific performance requirements.

Prescriptive Requirements: Provide products which have been produced in accordance with prescriptive requirements, using specified ingredients and components, and complying with specified requirements for mixing, fabricating, curing, finishing, testing and similar operations in manufacturing process.

SUBSTITUTIONS:
Conditions: Contractor's request for substitution will be received and considered when extensive revisions to contract documents are not required and changes are in keeping with general intent of contract documents; when timely, fully documented and properly submitted; and when one or more of following conditions is satisfied, all as judged by Architect/Engineer. Otherwise, requests will be returned without action except to record non compliance with these requirements.

Where required product, material or method cannot be provided in a manner which is compatible with other materials of the work, or cannot be properly coordinated therewith,

or cannot be warranted as required, or cannot be used without adversely affecting Owner's insurance coverage on completed work, or will encounter other substantial non compliance which are not possible to otherwise overcome except by making requested substitution, which Contractor thereby certifies to overcome such non compatibility, non coordination, non warranty, non insurability or other non compliance as claimed.

Work Related Submittals: Contractor's submittal of (and Architect/Engineer's acceptance of) shop drawings, product data or samples which relate to work not complying with requirements of contract documents, does not constitute an acceptable or valid request for a substitution, nor approval thereof.

GENERAL PRODUCT REQUIREMENTS:

General: Provide products which comply with requirements, and which are undamaged and unused at time of installation, and which are complete with accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for intended use and effect.

Standard Products: Where available, provide standard products of types which have been produced and used previously and successfully on other projects and in similar applications.

Nameplates: Except as otherwise indicated for required approval labels, and operating data, do not permanently attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view either in occupied spaces or on exterior of the work.

Labels: Locate required labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface which, in occupied spaces, is not conspicuous.

Equipment Nameplates: Provide permanent nameplate on each item of service connected or poser operated equipment. Indicate manufacturer, product name, model number, serial number, capacity, speed, ratings and similar essential operating data. Locate nameplates on an easily accessed surface which, in occupied spaces, is not conspicuous.

PART 3 EXECUTION (not applicable)

END OF SECTION 01605

SECTION 01705 - PROJECT CLOSEOUTS

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF REQUIREMENTS:

Definitions: Closeout is hereby defined to include general requirements near the end of the Contract Time, in preparation for final acceptance, final payment, normal termination of contract, occupancy by Owner and similar actions evidencing completion of the work. Specific requirements for individual units of work are specified in sections of Divisions 2 through 16. Time of closeout is directly related to “Substantial Completion", and therefore may be either a single time period for entire work which have been certified as substantially complete at different dates. That time variation (if any) shall be applicable to other provisions of this section.

PREREQUISITES TO SUBSTANTIAL COMPLETION:

General: Prior to requesting the Architect/Engineer's inspection for certification of substantial completion, (for either the entire work or for portions thereof), complete the following and list known exceptions in the request:

Submit specific warranties, workmanship/maintenance bonds, maintenance agreements, final certifications and similar documents.

Obtain and submit releases enabling Owner’s full, unrestricted use of the work and access to services and utilities (where required), include occupancy permits, operating certificates, and similar releases.

Deliver tools, spare parts, extra stocks of materials, and similar physical items to the Owner.

Attic stock or extra materials for the Owner are not to be used for punchlist or warranty work, unless permission is given. In such case, the material is to be restocked and provided to the Owner.

Make final changeover of locks and transmit the keys to the Owner, and advise the Owner's personnel of change over in security provisions.

Complete start up testing of systems, and instructions of the Owner’s operating and maintenance personnel. Discontinue or change over and remove temporary facilities and services from the project site, along with construction tools and facilities, mock ups, and similar elements.

Complete final cleaning up requirements, including touch up of painting of marred surfaces.

Inspection Procedures: Upon receipt of the Contractor's request Architect/Engineer will either proceed with inspection or advise Contractor of unfilled prerequisites. Following

the initial inspection, the Architect/Engineer will either prepare the certificate of substantial completion, or will advise the Contractor of work which must be performed prior to the issuance of certificate; and repeat the inspection when requested and when assured that the work has been substantially completed. Results of the completed inspection will form the initial "punch list" for final acceptance.

Attic Stock Quantities:

Vinyl Composition Tile:	(3) Boxes – Field Color
	(1) Box- Each Accent Color
Rubber Base:	60 LF
Corner Guards	(5) with anchors
Paint:	(2) 5-gallon - Field Color
	(1) 5-gallon – Each Accent Color
Ceramic Tile	(1) Carton – Each 2x2 Color
	(4) Cartons – Field 4x4 Color
	(2) Cartons – Each Accent 4x4 Color
Quarry Tile	(2) Cartons
Acoustical Ceiling	(4) Boxes – Type I
	(1) Boxes – Type II
	(1) Box – Type III
	(1) Box - Type IV
	(1) Box – Type V

SECTION 224713 - DRINKING FOUNTAINS

Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- Filter Cartridges: Equal to 10 percent of amount installed for each type and size indicated, but no fewer than 3 of each.

SECTION 233300 - AIR DUCT ACCESSORIES

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- Fusible Links: Furnish quantity equal to 10 percent of amount installed.

SECTION 233423 Power HVAC Ventilators

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- Belts: One set for each belt-driven unit.

SECTION 237413 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

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-drive fan (if applicable)
2. Filters: **One set** of filters for each unit.

SECTION 237433 - DEDICATED OUTDOOR-AIR UNITS

Furnish extra materials 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 for each unit.

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: **One** set for each air-handling unit.
2. Fan Belts: **One** set for each air-handling unit fan.

SECTION 260943.23 - RELAY-BASED LIGHTING CONTROLS

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lighting Control Relays: Equal to percent of amount installed for each size indicat**ed**, but no fewer than.

SECTION 262413 SWITCHBOARDS

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 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.
- 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.
- 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.
- 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.
- 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.
- Indicating Lights: Equal to 10 percent of quantity installed for each size and type but no less than one of each size and type.

SECTION 262416 - PANELBOARDS

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- Keys: Two spares for each type of panelboard cabinet lock.
- Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
- 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.

SECTION 262726 - WIRING DEVICES

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- Service/Power Poles: One for every 10, but no fewer than one.
- Floor Service-Outlet Assemblies: One for every 10 but no fewer than one.
- Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.

SECTION 262813 – FUSES

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
- Fuse Pullers: Two for each size and type.

SECTION 262913 - ENCLOSED CONTROLLERS

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 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.
- 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.
- Indicating Lights: Two of each type and color installed.
- Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.

- Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

SECTION 265116 - INTERIOR LIGHTING

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
- Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
- Fluorescent-luminaire-mounted emergency battery pack: One for every 40 emergency lighting unit.
- Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

SECTION 265219 - EMERGENCY AND EXIT LIGHTING

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
- Luminaire-mounted, emergency battery pack: One for every 20 emergency lighting units. Furnish at least one of each type.
- Diffusers and Lenses: two for every 100 of each type and rating installed. Furnish at least one of each type.
- Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

SECTION 265621 - EXTERIOR LIGHTING

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
- Glass, Acrylic, and Plastic Lenses, Covers and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
- Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
- Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.
- Ballasts: One for every 100 f each type and rating installed. Furnish at least one of each type.

SECTION 267240 - INTRUSION DETECTION

Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- Intrusion Detection Devices: Furnish quantity equal to two percent of the number of units of each type installed, but no less than one of each type.

PREREQUISITES TO FINAL ACCEPTANCE:

General: Prior to requesting Architect/Engineer's final inspection for certification of final acceptance, and final payment, as required by the General Conditions, complete the following and list known exceptions, (if any), in request.

Submit the final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.

Submit an updated final statement, accounting for final additional changes to the Contract Sum.

Submit certified copy of the Architect/Engineer's final punch list of itemized work to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance and has been endorsed and dated by the Architect.

Submit consent of surety.

Re-inspection Procedure: Upon receipt of the Contractor's notice that the work has been completed, including punch list items resulting from earlier inspections, and excluding incomplete items delayed because of acceptable circumstances, the Architect/Engineer will re-inspect the work.

Upon completion of re-inspection, the Architect/Engineer will either prepare a certificate of final acceptance, or will advise the Contractor of work that is incomplete or obligations not fulfilled, as required for final acceptance. If necessary, procedure will be repeated.

RECORD DOCUMENT SUBMITTALS:

General: Specific requirements for record documents are indicated in individual sections of these specifications. Other requirements are indicated in the General Conditions. General submittal requirements are indicated in the "Submittals" sections. Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire resistive location; provide access to record documents for Architect/Engineer's reference during normal working hours.

Record Drawings: Maintain a white print set (blue line or white prints of contract drawings and shop drawings in a clean, undamaged condition with mark up of actual installations which vary substantially from the work as originally shown. Mark whichever drawing is most capable of showing the actual "field" condition fully and accurately; however, where shop drawings are used for mark up, record a cross reference at the

corresponding location on the working drawings. Mark with legible erasable pencil and, where feasible, use other colors to distinguish between variations in separate categories of work. Verify colors will be visible during scanning of record drawings. Mark up new information which is recognized to be of importance to Owner, but was for some reason not shown on either contract drawings or shop drawings. Give particular attention to concealed work that would be difficult to measure and record at a later date. Note related change order numbers where applicable. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on cover of each set.
Provide two electronic copies on CD of the record drawings to the Owner.

Record Specifications: Maintain one copy of specifications, including addenda, change orders and similar modifications issued in printed form during construction, and mark up variations (of substance) in the actual work in comparison with the text of the specifications and modifications as issued. Give particular attention to substitutions, selection of options and similar information on work where it is concealed or cannot otherwise be readily discerned at a later date by direct observation. Note related record drawing information and product data, where applicable. Upon completion of mark up, submit to Architect/Engineer for Owner’s records.

Record Product Data: Maintain one copy of each product data submittal, and mark up significant variations in actual work in performed in comparison with the submitted information. Include both variations in product as delivered to site, and variations from the manufacturer's instructions and recommendations for installation. Give particular attention to concealed products and portions of the work which cannot otherwise be readily discerned at a later date by direct observation. Note related change orders and mark up of record drawings and specifications. Upon completion of mark up, submit complete set to Architect/Engineer for the Owners' records.

Miscellaneous Record Submittals: Refer to other sections of these specifications for requirements of miscellaneous record keeping and submittals in connection with the actual performance of the work. Immediately prior to the date(s) of substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to the Architect/Engineer for the Owner's records.

Maintenance Manuals: Organize maintenance and operating manual information into suitable sets of manageable size, and bind into individual binders properly identified and indexed (thumb tabbed). Include emergency instructions, spare parts listing, and copies of warranties, wiring diagrams, recommended "turn around" cycles, inspection procedures, shop drawings, product data, and similar applicable information. Bind each manual of each set of data in a heavy duty 2", 3 ring vinyl covered binder, and include pocket folders for folded sheet information. Mark identification on both front and spine of each binder.

PART 2 PRODUCTS (not applicable)

PART 3 EXECUTIONS

CLOSEOUT PROCEDURES:

General Operating and Maintenance Instructions: Arrange for each installer of work requiring continuing maintenance or operation, to meet with Owner's personnel, at the

project site, to provide basic instruction needed for proper operation and maintenance of the entire work. Include instructions by the manufacturer's representatives where installers are not experts in the required procedures. Review maintenance manuals, record documentation, tools, spare parts and materials, lubricants, fuels identification system, control sequences, hazards, cleaning and similar procedures and facilities. For operational equipment, demonstrate start up, shut down, emergency operations, noise and vibration adjustments, safety, economy and efficiency adjustments energy effectiveness, and similar operations. Review maintenance and operations in relation with applicable warranties, agreements to maintain, bonds and similar continuing commitments.

FINAL CLEANING:

General: Special cleaning for specific units of work is specified in sections of Divisions 2 through 16. General cleaning during the progress of the work is specified in General Conditions and as "Temporary Facilities" section of this Division. Provide final cleaning of the work, at time indicated, consisting of cleaning each surface or unit of work to normal "clean" condition expected for a first class building cleaning and maintenance program. Comply with manufacturer's instructions for cleaning operations. The following are examples but not by way of limitation, of cleaning levels required.

Remove labels which are not required as permanent labels.

Clean transparent materials, including mirrors and window/door glass, to a polished condition, removing substances which are noticeable as vision obscuring materials. Replace broken glass and damaged transparent materials.

Clean exposed exterior and interior hard surface finishes to a dirt free condition, free of dust, stains, films and similar noticeable distracting substances. Except as other-wise indicated, avoid disturbance of natural weathering of exterior surface. Restore reflective surfaces to their original reflective condition.

Wipe surfaces of mechanical and electrical equipment clean, including elevator equipment and similar equipment; remove excess lubrication and other substances.

Remove debris and surface dust from limited access spaces including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics and similar spaces.

Clean concrete floors in non-occupied spaces broom clean. Vacuum clean carpeted surfaces and similar soft surfaces.

Clean plumbing fixtures to a sanitary condition, free of stains including those resulting from water exposure.

Clean food service equipment to a condition of sanitation ready and acceptable for intended food service use.

Clean light fixtures and lamps so as to function with full efficiency.

Clean project site (yard and grounds), including landscape development areas, of litter and foreign substances.

Sweep paved areas to a broom clean condition; remove stains, petro chemical spills and

other foreign deposits. Rake ground which are neither planted nor paved, to a smooth, even textured surface.

Pest Control: Engage an experienced exterminator to make a final inspection of project and to rid project of rodents, insects, and other pests.

Removal of Protection: Except as otherwise indicated or requested by the Architect/Engineer, remove temporary protection devices and facilities which were installed during the course of the work to protect previously completed work during the remainder of the construction period.

Compliance: Comply with safety standards and governing regulations for cleaning operations. Do not burn waste materials at the site. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile or other harmful or dangerous materials into drainage systems. Remove waste materials from site and dispose of in a lawful manner.

Close Required Documents

Required Documents provided to Owner:

- 2 - Sets of As Built Drawings (Hard Copy)
  - 1 Set is to be provided to Central Administration Facilities Manager
  - 1 Set is to be provided to the Project Specific Campus Facility Manager

- 1 – CD of As Built Drawings provided to Central Administration Facilities Manager

- 2 - Sets of Close Out Binders
  - 1 Set is to be provided to Central Administration Facilities Manager
  - 1 Set is to be provided to the Project Specific Campus Facility Manager.

Required Electronic Documents sent to Owner's Representative:

- Punch Lists
- Special Tests
- Special Inspector Sign - Off
- Asbestos Affidavit
- Certificate of Occupancy
- Certificate(s) of Substantial Completion
- Owner Training / System Demonstrations (Sign - in sheet w/ hours)
- Change Orders
- As Built Drawings
- Spare Parts / Attic Stock (Transmittal of delivery to Campus & IDEA sign - off)
- Subcontractor / Supplier Contact List
- Warranties
- Elevation Certificates
- Final Release of Liens
- Consent of Surety

END OF SECTION 01705

SECTION 01913 - GENERAL COMMISSIONING 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.

B. Basis-of-Design documentation is referenced for information only, and not included here.

1.2 SUMMARY

A. Section Includes:

1. General requirements for coordinating and scheduling commissioning.
2. Commissioning meetings.
3. Commissioning reports.
4. Equipment and systems installation, startup, and field quality-control testing indicated in the Contract Documents.
5. Use of test equipment, instrumentation, and tools for commissioning.
6. System readiness checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
7. Commissioning tests and commissioning test demonstration.
8. Work to correct commissioning issues.
9. Work to repeat tests when equipment and systems fail acceptance criteria.
10. Adjusting, verifying, and documenting identified systems and assemblies.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submittal procedures requirements for commissioning.
2. Section 017700 "Closeout Procedures" for certificate of Construction Phase Commissioning Completion submittal requirements.
3. Section 017823 "Operation and Maintenance Data" for preliminary operation and maintenance data submittal.
4. Section 230800 "Commissioning of HVAC" for technical commissioning requirements for HVAC.
5. Section 260800 "Commissioning of Electrical Systems" for technical commissioning requirements for electrical systems.

1.3 DEFINITIONS

A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, system readiness checklists, performance tests, performance test demonstrations, commissioning tests and commissioning test demonstrations.

B. Basis-of-Design Document (BoD): A document prepared by Engineer, or Commissioning Authority that records concepts, calculations, decisions, and product selections used to comply with Owner's Project Requirements and to suit applicable regulatory requirements, standards, and guidelines.

C. Commissioning Authority (CxA): An entity engaged by Owner, and identified in Section 011000 "Summary," to evaluate Commissioning-Process Work.

D. Commissioning Plan: A document, prepared by Commissioning Authority, that outlines the organization, schedule, allocation of resources, and documentation requirements of commissioning.

E. Commissioning (Cx): A quality-focused process for verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, and tested to comply with Owner's Project Requirements. The requirements specified here are limited to the construction phase commissioning activities. The scope of commissioning is defined in this section and is in accordance with the requirements in the IECC.

F. Construction Phase Commissioning Completion: The stage of completion and acceptance of commissioning when resolution of deficient conditions and issues discovered during commissioning and retesting until acceptable results are obtained has been accomplished. Owner will establish in writing the date Construction Phase Commissioning Completion is achieved. See Section 017700 "Closeout Procedures" for certificate of Construction Phase Commissioning Completion submittal requirements.

1. Commissioning is complete when the work specified in this Section and related Sections has been completed and accepted, including, but not limited to, the following:

    a. Completion of tests and acceptance of test results.
    b. Resolution of issues, as verified by retests performed and documented with acceptance of retest results.
    c. Comply with requirements in Section 017900 "Demonstration and Training."
    d. Completion and acceptance of submittals and reports.

G. Functional Test: Test of dynamic function of systems, as opposed to components, under full operation in various modes through all control system’s sequences of operation using manual (direct observation) or monitoring methods following prescribed test procedures in sequential written form

H. Owner's Project Requirements (OPR): A document that details the functional requirements of a project and the expectations of how it will be used and operated, including Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

I. Owner's Witness: Commissioning Authority, Owner's Project Manager, or Architect-designated witness authorized to authenticate test demonstration data and to sign completed test data forms.

J. Construction or System readiness Checklist: List, provided by Commissioning Authority to installer, of items to inspect and elementary component tests to conduct to verify proper installation of equipment prior to functional testing.

K. Sampling: Functionally testing only a fraction of total number of identical or near identical pieces of equipment.

L. Seasonal Commissioning: Testing of equipment that can be done only during periods of peak heating or cooling, when HVAC equipment is operating at full-load or heavy-load conditions.

M. Simulated Condition: Condition created for purpose of testing response of system.

N. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

O. Test: Performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.

P. Trending: Monitoring using building control system.

1.4 COMPENSATION

A. Should Architect, Commissioning Authority, other Owner's witness, or Owner's staff perform additional services or incur additional expenses due to actions of Contractor listed below, compensate Owner for such additional services and expenses.

1. Failure to provide timely notice of commissioning activities schedule changes.
2. Failure to meet acceptance criteria for test demonstrations.

B. Contractor shall compensate Owner for such additional services and expenses at the rate of $150.00 per labor hour plus $100.00 per round trip plus per diem allowances for meals and lodging according to current U.S. General Services Administration (GSA) Per Diem Rates.

1.5 COMMISSIONING TEAM

A. Members Appointed by Contractor(s):

1. Commissioning Coordinator: A person or entity employed by Contractor to manage, schedule, and coordinate commissioning.
2. Project superintendent and other employees that Contractor may deem appropriate for a particular portion of the commissioning.
3. Subcontractors, installers, suppliers, and specialists that Contractor may deem appropriate for a particular portion of the commissioning.
4. Appointed team members shall have the authority to act on behalf of the entity they represent.

B. Members Appointed by Owner:

1. Commissioning Authority (CxA), plus consultants that CxA may deem appropriate for a particular portion of the commissioning.

a. CxA: Ethos Engineering, Mark Warren, PE. Cell (512) 563-3495

2. Owner representative(s), facility operations and maintenance personnel, plus other employees, separate contractors, and consultants that Owner may deem appropriate for a particular portion of the commissioning.

    a. Owner's Rep: Director of Facilities and Construction.

3. Architect, plus employees and consultants that Architect may deem appropriate for a particular portion of the commissioning.

    a. Architect: GMS Architects

4. MEP Engineer, plus employees and consultants that Architect may deem appropriate for a particular portion of the commissioning.

    a. MEP: Ethos Engineering, Guillermo Quintanilla. Cell (956) 564-2811.

1.6 INFORMATIONAL SUBMITTALS

A. Comply with requirements in Section 013300 "Submittal Procedures" for submittal procedures general requirements for commissioning.

B. Commissioning Plan Information:

1. List of Contractor-appointed commissioning team members to include specific personnel and subcontractors to the performance of the various commissioning requirements.
2. Schedule of commissioning activities, integrated with the construction schedule. Comply with requirements in Section 013200 "Construction Progress Documentation" for construction schedule general requirements for commissioning.
3. Contractor personnel and subcontractors to participate in each test.
4. List of instrumentation required for each test to include identification of parties that will provide instrumentation for each test.

C. Commissioning schedule.

D. Two-week look-ahead schedules.

E. Test Reports:

1. Pre-Startup Report: Prior to startup of equipment or a system, submit signed, completed system readiness checklists.
2. Test Data Reports: At the end of each day in which tests are conducted, submit test data for tests performed.
3. Commissioning Issues Reports: Daily, at the end of each day in which tests are conducted, submit commissioning issue reports for tests for which acceptable results were not achieved.
4. Weekly Progress Report: Weekly, at the end of each week in which tests are conducted, submit a progress report.
5. Data Trend Logs: Submit data trend logs at the end of the trend log period.

6. System Alarm Logs: Daily, at the start of days following a day in which tests were performed, submit print-out of log of alarms that occurred since the last log was printed.

F. System readiness checklists:

1. Material checks.
2. Installation checks.
3. Startup procedures, where required.

1.7 CLOSEOUT SUBMITTALS

A. Commissioning Report:

1. At Construction Phase Commissioning Completion, include the following:

a. Pre-startup reports.
b. Test data forms, completed and signed.
c. Commissioning issues report log.
d. Commissioning issues reports showing resolution of issues.
e. Correspondence or other documents related to resolution of issues.
f. Other reports required by commissioning.
g. List unresolved issues and reasons they remain unresolved and should be exempted from the requirements for Construction Phase Commissioning Completion.
h. Report shall include commissioning work of Contractor.

B. Request for Certificate of Construction Phase Commissioning Completion.

C. Operation and Maintenance Data: For proprietary test equipment, instrumentation, and tools to include in operation and maintenance manuals.

1.8 COMMISSIONING TEAM RESPONSIBILITIES

A. COMMISSIONING AUTHORITY: Responsibilities of the CxA during the Construction Phase include the following:
1. Coordinate and direct steps of the total Commissioning Process for systems being installed as part of this contract. Coordinate commissioning work schedule with Owner and Contractor.
2. Provide Commissioning Plan.
3. Attend planning and construction-site meetings as required to obtain information relating to Commissioning Process. Convene commissioning team meetings as required.
4. Plan and conduct commissioning scoping and coordination meetings. Provide notice to all Team members to attend scheduled commissioning meetings.
5. Request all information required for Commissioning Process from manufacturers, Contractor, and Design Professionals.
6. Verify that systems and equipment have been installed and started in accordance with manufacturer's recommendations and with generally recognized construction standards, and that documentation of such has been provided.
7. Assist in resolving discrepancies.

8. Prepare System readiness checklists to ensure systems have been installed according to project specifications. Verify that System readiness checklists have been addressed by Contractor and are accurate. Deliver final System readiness checklists to Owner.
9. Prepare Functional Test procedures to demonstrate performance of systems according to project specifications. Observe and document performance of systems, as per process detailed in Functional Test procedures.
10. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, system readiness checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.
11. Prepare and maintain an Issues Log.
12. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.
13. Review testing and balancing (TAB) reports; notify Owner of deficiencies.
14. Recommend acceptance or non-acceptance of systems to Owner.
15. Verify that training has taken place by collecting training documentation from Contractor.
16. Compile and maintain commissioning record.
17. Provide pre-final and final commissioning reports to all commissioning team members. The report shall include:
    a. Communications between Owner, CxA, Design Professionals, Vendors, and/or Contractor and Subcontractors related to Commissioning Process.
    b. Minutes of commissioning meetings.
    c. Findings and pertinent observations.
    d. A listing of any deficiencies, unresolved issues, and compromises in the environmentally responsive features.
    e. Manufacturer's start-up reports.
    f. An Issues Log which:
        1) Describes design, installation, and performance issues which are at variance with the Owner's project requirements and Contract Documents.
        2) Identifies and tracks issues as they are encountered, documenting the status of unresolved and resolved issues.
        3) Documents corrective modifications made.
    g. System readiness checklists.
    h. Testing plans and Functional Test reports.
    i. Listing of off-season test(s) not performed and a schedule for their completion.
18. Conduct an inspection of the building and its systems within 10 months after substantial completion and prior to the expiration of warranties. Prepare a report documenting findings that should be addressed prior to expiration of warranties.

B. CONTRACTOR: Responsibilities of the General Contractor (GC) as related to Commissioning Process include, but are not limited to the following:
1. Facilitate coordination of Commissioning work by CxA.
2. Attend Commissioning meetings or other meetings called by CxA to facilitate the Commissioning Process.
3. Integrate and coordinate commissioning process activities with construction schedule.
4. Review CxA's Functional Test procedures for feasibility, safety, and impact on warranty, and provide CxA with written comment on same.

5. Provide all documentation relating to manufacturer's recommended performance testing of equipment and systems.
6. Provide Operations and Maintenance Data to CxA for preparation of checklists and training manuals.
7. Provide testing and balancing report.
8. Provide As-built drawings and documentation to facilitate Functional Testing.
9. Assure and facilitate participation and cooperation of specialty subcontractors (electrical, mechanical, Building Automation, etc.), and equipment suppliers as required for the Commissioning Process.
10. Require subcontractors to inspect systems installed and fill-out System readiness checklists (provided by CxA) to verify installation has taken place in accordance with manufacturer's instructions, and in a workmanlike manner in accordance with project documents and generally accepted construction practices. Certify to CxA that installation work listed in System readiness checklists has been completed and accompany CxA during verification of completed System readiness checklists.
11. Install systems and equipment in strict conformance with project specifications, manufacturer's recommended installation procedures, and System readiness checklists, as prepared by CxA.
12. Provide data concerning performance, installation, and start-up of systems.
13. Provide copy of manufacturer's filled-out start-up forms for equipment and systems.
14. Ensure systems have been started and fully checked for proper operation prior to arranging for Functional Testing with CxA. Prepare and submit to CxA written certification that each piece of equipment and/or system has been started according to manufacturer's recommended procedure, and that system has been tested for compliance with operational requirements.
    a. GC shall carry out manufacturer's recommended start-up and testing procedures, regardless of whether or not they are specifically listed in CxA's Functional Test procedures.
    b. GC is not relieved of obligation for systems / equipment demonstration where performance testing is required by specifications, but a Functional Performance Test is not specifically designated by CxA.
15. Coordinate with CxA to determine mutually acceptable date of Functional Performance Tests.
16. Review and accept construction checklists provided by the CxA.
17. Direct and coordinate commissioning testing among subcontractors, suppliers, and vendors.
18. Complete commissioning process test procedures.
19. Provide qualified personnel to assist and participate in Commissioning.
20. Provide test instruments and communications devices, as prescribed by CxA and where identified in this specifications manual, as required for carrying out Functional Testing of systems.
21. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
22. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
23. Ensure deficiencies found in the Commissioning Process are corrected within the time schedule shown in the CA report.
24. Provide CxA with all submittals, start-up instructions manuals, operating parameters, and other pertinent information related to Commissioning Process. This information shall be provided directly to the CxA as a digital PDF file at the same time that the submittals are made to the architect and/or engineer.
25. Prepare and submit to CxA proposed Training Program outline for each system.

26. Coordinate and provide training of Owner's personnel. Provide CxA with proposed training agenda no less than 14 days prior to scheduled training sessions. Provide documentation that training took place (including system being trained on, trainer's name and contact information, sign-in sheet verifying who attended training, length of training, and signature of owner's authorized person certifying training took place satisfactorily).
27. Prepare Operation and Maintenance manuals and As-Built drawings in accordance with specifications; submit copy to CxA in addition to other contractually required submissions. Revise and resubmit manuals in accordance with Design Professionals and CxA's comments.
28. All costs associated with the participation of GC, Sub-Contractors, Design Professionals, and Equipment Vendors in the Commissioning Process shall be included as part of the Construction Contract.

C. Subcontractors and vendors shall prepare and submit to Commissioning Authority Manufacturer's installation and performance test procedures to demonstrate performance of systems according to these specifications and checklists prepared by Commissioning Authority.

D. Owner's Representative: Responsibilities of the Owner's Representative as related to Commissioning Process include, but are not limited to the following:

1. Provide the OPR documentation to the CxA and GC for information and use.
2. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
3. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CxA and GC for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.
4. Manage contracts of Architect and GC.
5. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions.
6. Provide final approval for completion of Commissioning Work.
7. Warranty Period: Ensure that seasonal or deferred testing and deficiency issues are addressed.

E. Architect: Responsibilities of the Architect as related to Commissioning Process include, but are not limited to the following:

1. Attend commissioning scoping meeting and other commissioning team meetings as requested by Commissioning Authority and as selected by Architect.
2. Perform normal submittal review, construction observation, record drawing preparation, and operations and maintenance data preparation, as required by Contract Documents.
3. Coordinate resolution of system deficiencies identified during commissioning, as required by Contract Documents. Review Commissioning Issues Logs and issue directives to GC and/or Design Professionals as applicable.
4. Prepare and submit final as-built design intent documentation for inclusion in Operation and Maintenance Data Manual, and review and approve Operation and Maintenance Data Manual.
5. Review Commissioning Report and issue directive to resolve all outstanding deficiencies prior to project close-out.
6. Warranty Period: Coordinate resolution of design non-conformance and design deficiencies identified during warranty period commissioning.

F. Design Professionals Responsible for Design of Each Portion of Work Being Commissioned:

1. Perform normal submittal review, construction observations, and record drawing preparation, as required by Contract Documents. Perform site observation immediately preceding system startup.
2. Respond to deficiencies identified by Commissioning Authority as directed by Architect.
3. Provide design narrative and sequence documentation requested by Commissioning Authority. Assist, along with GC, in clarifying operation and control of commissioned equipment in areas where specifications, control drawings, or equipment documentation are not sufficient for writing detailed testing procedures.
4. Attend commissioning scoping meetings and other commissioning team meetings as requested by Commissioning Authority and as selected by Architect or responsible design professional.
5. Participate in resolution of system deficiencies identified during commissioning, as required by Contract Documents.
6. Prepare and submit final as-built design intent and operating parameters documentation for inclusion in Operation and Maintenance Manual, and review and approve Operation and Maintenance Manual.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

A. Test equipment and instrumentation required to perform the commissioning shall remain the property of Contractor unless otherwise indicated.

2.2 REPORT FORMAT AND ORGANIZATION

A. General Format and Organization:

1. Bind report in three-ring binders.
2. Label the front cover and spine of each binder with the report title, volume number, project name, Contractor's name, and date of report.
3. Record report on compact disk.
4. Electronic Data: Portable document format (PDF); a single file with outline-organized bookmarks for major and minor tabs and tab contents itemized for specific reports.

B. Commissioning Report:

1. Include a table of contents and an index to each test.
2. Include major tabs for each Specification Section.
3. Include minor tabs for each test.
4. Within each minor tab, include the following:

a. Test specification.
b. Pre-startup reports.
c. Test data forms, completed and signed.

d. Commissioning issue reports, showing resolution of issues, and documentation related to resolution of issues pertaining to a single test. Group data forms, commissioning issue reports showing resolution of issues, and documentation related to resolution of issues for each test repetition together within the minor tab, in reverse chronological order (most recent on top).

PART 3 - EXECUTION

3.1 PREPARATION

A. Review preliminary system readiness checklists and preliminary test procedures and data forms.

3.2 GENERAL

A. Authority
1. The Commissioning Authority carries out the Cx responsibilities as the Owner's authorized agent in accordance with plans, specifications, and contractual requirements.
2. CxA reports deficiencies found to the GC, Architect and Owner.
3. The Architect evaluates deficiencies and issues directive to GC to remedy CxA's deficiencies lists, in accordance with contract documents.
4. No change in scope work is to take place without express written consent of Owner. Any deficiencies identified by CxA that are deemed by Architect to be outside of the scope of work shall be discussed with Owner for consideration.
5. GC and CxA are to copy Architect on all correspondence related to the commissioning process.

B. Participation In The Commissioning Process
1. GC shall attend meetings related to Commissioning process and arrange for attendance by subcontractors and vendors prior to commissioning of their systems, at the discretion of CxA.
2. Provide skilled technicians to start and test all systems, and place systems in complete and fully functioning service in accordance with contract documents and design intent.
3. Provide skilled technicians, experienced and familiar with systems being commissioned, to assist CxA in commissioning process.
4. Attend initial commissioning team scoping meeting, pre-commissioning meetings specific to each system, and other meetings requested by CxA as required to discuss resolution of deficiencies.
5. Coordinate with sub-Contractors and equipment vendors/representatives to set aside adequate time to address System readiness Checklists, Functional Testing, Operations and Maintenance Training, and associated coordination meetings.

C. Work Prior To Testing
1. A commissioning team scoping meeting shall be held at a time and place designated by Commissioning Authority. Owner, Architect, Commissioning Authority, Contractor, and Mechanical, Electrical, and Controls Contractors, shall be present at this meeting. The main objectives of the meeting are to familiarize all parties with the requirements of the commissioning process; to ensure that the responsibilities of each party are clearly

understood; and obtain information to develop the preliminary commissioning plan, including:

a. Personnel representing the various entities participating in the process (GC, subcontractors, Owner, Architect, Engineer, CxA)
b. Lines of communications;
c. Assignment of responsibilities;
d. Review system readiness checklists;
e. Submittal schedule;
f. Preliminary construction schedule

2. Following the initial commissioning team scoping meeting, and upon reviewing submittals, CxA shall prepare a preliminary Commissioning Plan outlining procedures and responsibilities, including names and contact information of responsible parties, tentative dates for commissioning activities, and system readiness checklists. Preliminary Commissioning Plan shall be distributed to GC and Owner electronically for review and comment. CxA shall modify the Commissioning Plan based on feedback from GC and Owner and will generate a final Cx Plan.
3. Prior to system readiness and functional testing, CxA will conduct site inspections at critical times and issue Cx Field Reports with observations on installation deficiencies so that they may be issued by Architect as deemed appropriate
4. GC shall complete all phases of the work so the systems can be started, tested, adjusted, balanced, and otherwise commissioned.
5. GC shall verify requirements of Divisions 22, 23 and 26 outlining responsibilities for start-up of equipment with obligations to complete systems, including all sub-systems so that they are fully functional.
6. A minimum of fourteen (14) days prior to date of system readiness performance test, submit to Commissioning Authority for review, detailed description of equipment start-up procedures which GC proposes to perform to demonstrate conformance of systems to specifications and commissioning checklists.
7. Convene system-specific pre-commissioning meetings prior to start of system readiness testing of each system. The GC shall hold a pre-commissioning meeting with all Team members in attendance. The purpose of the meeting is to review the system readiness checklists, and equipment start-up procedures for each system to be commissioned, confirm that systems are ready for testing, and define a schedule for testing activities.

D. System readiness checks and functional performance tests

1. The GC shall provide all materials, services, and labor required to operate equipment and/or system in order to perform the system readiness checks and functional performance tests. A system readiness check or functional performance test shall be aborted if any system deficiency prevents the successful completion of the test or if any participating commissioning team member of which participation is specified is not present for the test. The GC shall reimburse the Owner and A/E for all costs associated with effort lost due to tests that are aborted. These costs shall include salary, travel costs and per diem (where applicable).
2. Functional performance tests may sometimes duplicate the checking, testing, and inspection methods established in related Sections. Where checking, testing, and inspection methods are not specified in other Sections, methods shall be established which will provide required information. Testing and verification required by this section shall be performed during the Commissioning phase. Requirements in related Sections are independent from the requirements of this Section and shall not be used to satisfy any of the requirements specified in this Section without the approval of CxA.

3. Follow start-up and initial checkout procedures listed in article titled "RESPONSIBILITIES" in Part 1, and additional requirements specified in this Section. Divisions 22, 23 and 26 have startup responsibilities and are required to complete systems and sub-systems so systems are fully functional, meeting design requirements of Contract Documents. Commissioning procedures and functional testing do not relieve or lessen this responsibility or shift this responsibility, in whole or in part, to Commissioning Agent or Owner.

E. Work To Resolve Deficiencies
1. Complete corrective work in a timely manner to allow expeditious completion of commissioning process. If deadlines pass without resolution of identified problems, Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs thus incurred will be GC's responsibility.

3.3 SUSTAINABILITY REQUIREMENTS

A. Comply with requirements listed in specifications and drawings as it relates to sustainability features that will be verified during the Commissioning process.

3.4 SYSTEM READINESS CHECKLISTS

A. General
1. System readiness checklists are important to ensure that equipment and systems are properly connected and operational, and installed in accordance with specifications, drawings, manufacturer's requirements, and all applicable codes.
2. Checklists ensure that functional performance testing (in-depth checkout) may proceed without unnecessary delays.
3. Performance of system readiness checklists, startup, and checkout shall be directed and executed by subcontractor or vendor. Only individuals that have direct knowledge and who witnessed that line item task on system readiness checklist was performed shall initial or check item off.
4. Each piece of equipment and major distribution system receive full system readiness checkout. No sampling strategies are used.
5. System readiness checkout for given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of given system.

B. System readiness Checklist
1. System readiness performance tests shall be documented in a checklist format, as prepared and provided by CxA, for each piece of equipment. Each checklist shall be initialed by GC, verifying that all items on checklist have been addressed and completed.
2. Commissioning System readiness checklists are not to preclude GC from applying his own construction inspection checklists.
3. All system elements shall be checked to verify that they have been installed, adjusted, and calibrated properly, that all connections have been made correctly, and that it is ready to function as specified. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, control sequence, and other conditions which may cause damage.
4. Verify that tests, meter readings and specific electrical characteristics agree with those required by equipment or system manufacturer.

5. All discrete elements and sub-systems shall be adjusted and shall be checked for proper operation. Verify wiring and support components for equipment are complete and tested.
6. Do not conduct start-up procedure recommended by equipment/system manufacturer at prior to system readiness testing.
7. Subcontractors shall clearly list outstanding items of initial start-up and system readiness procedures that were not completed successfully at bottom of procedures form or on separate sheet attached to form. Completed forms and attached sheets shall be provided to Commissioning Authority within 2 days of test completion. Installing subcontractor or vendor shall correct deficient or incomplete areas in timely manner and shall submit updated system readiness checklist and startup report with statement of correction on original non-compliance report.
8. When system readiness checklists for a particular system or subsystems are completed, GC will request verification by CxA. GC and subcontractors shall accompany CxA during system readiness checklist verification.
9. If during system readiness checklist verification, CxA finds a significant number of deficiencies, GC shall have all the checklists associated with similar system redone.

3.5 SYSTEM START-UP

A. GC will arrange for start-up of operating equipment and systems after (or at the same time as) system readiness testing and prior to scheduling Functional Testing.

B. Start-up of equipment and systems shall be performed only by a manufacturer's representative, or person(s) who are specifically manufacturer-approved. All start-up personnel shall be trained and authorized, experienced and knowledgeable in the operations of such equipment and systems.

C. Coordinate schedule for start-up of various equipment and systems so that subsystems required for major systems operation are tested first.

D. Manufacturer's start-up reports must be submitted to CxA prior to scheduling Functional Testing.

3.6 FUNCTIONAL TESTING

A. The objective of Functional Testing is to demonstrate that each system is operating according to documented design intent and Contract Documents, through all possible modes of operation.

B. GC and sub-Contractors shall include in his bid proposal all costs associated with preparation and execution of Testing Procedures for all systems to be commissioned.

C. Functional testing is intended to begin upon completion of each system and after system readiness checklists have been completed. Functional testing may proceed prior to completion of systems or sub-systems at discretion of Commissioning Authority. Beginning system testing before completion does not relieve GC from fully completing system, including system readiness checklists as early as possible.

D. GC and sub-Contractors shall provide detailed Testing Procedures that will allow all items on checklists to be verified.

E. Testing shall be conducted under specified operating conditions as recommended or approved by Commissioning Authority.

F. A Functional Performance Test shall be performed on each complete system. Each function shall be demonstrated to the satisfaction of Commissioning Authority in accordance with proposed test procedures developed to demonstrate compliance with specifications.

G. Each Functional Test shall be witnessed and signed off by Commissioning Authority upon satisfactory completion. Functional Test is not to be considered complete until Owner accepts Commissioning Authority's recommendation for completion.

H. All elements of system shall be tested to demonstrate that total systems satisfy all requirements of these specifications. Testing shall be accomplished on hierarchical basis. Test each piece of equipment for proper operation, followed by each subsystem, followed by the entire system, followed by any inter-ties to other major systems.

I. Notification, Scheduling Of Functional Testing and Re-Testing
   1. Notify CxA and Owner, in writing, of request for scheduling Functional Testing. Submit request no fewer than five days prior to desired date for beginning functional testing.
      a. GC must certify that systems and equipment are functioning satisfactorily, according to specifications and design intent, prior to requesting Functional Testing. Upon receipt of such certification, CxA will schedule with GC a time for the particular system test.
         1) CxA will attempt to schedule Functional Testing when convenient for GC and his vendors, and to minimize lost time to GC.
      b. GC will resolve all deficiencies identified during initial test prior to submitting request, in writing, for re-testing. Such request for re-testing shall certify that GC has resolved all deficiencies, or list reason why any deficiencies remain which cannot be resolved.
      c. CxA will re-test to ensure that all deficiencies have been resolved.
         1) Deficiencies that were not detected in first Functional Test, but are discovered in subsequent re-testing, are to be resolved by GC as if they had been discovered in initial testing.

J. Functional Testing Requirements And Procedures
   1. GC and sub-Contractors shall perform tests in the presence of CxA. Tests not witnessed by CxA shall not be considered complete.
   2. To facilitate Functional Testing, when requested by CxA, GC shall provide services of personnel to accompany CxA for the duration of Functional Testing, including any follow-up testing. Such personnel must be experienced, qualified, and intimately familiar with the system being tested.
      a. Participation by representative(s) of direct digital controls (DDC) systems is of particular importance in Functional Testing. All systems which are controlled and/or monitored by DDC are to be thoroughly tested, point by point, through all modes of operation, with the assistance of manufacturer's representative. DDC graphics, setpoints, and programming are to be included as a part of Functional Testing as well.
      b. GC must provide services of personnel to accompany CxA for equipment and systems which may pose particular health and safety concerns, such as boilers.
      c. Should he fail to provide representative to accompany CxA during Functional Testing, GC continues to bear full responsibility for equipment warranty. Owner

and CxA will not be held responsible for damage to equipment, or other actions which might impact warranty, when performing Functional Testing of systems where GC has not provided authorized accompanying representative to operate equipment.

3. Each system shall be operated through all modes of operation including, but not limited to seasonal, occupied, unoccupied, warm-up, cool-down, part-load, and full-load, where system response is specified.
    a. For multiple units, sampling strategy established by Commissioning Authority and subject to approval of Owner may be used.
    b. Verification of each sequence in sequences of operation is required.
    c. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, and the like, shall also be tested.
4. Where possible, inspections carried out on systems by local Authorities Having Jurisdiction (AHJ) may serve as Functional Testing for purposes of Commissioning.
    a. CxA will accompany AHJ during testing procedures required by AHJ.
    b. It is responsibility of GC to arrange for testing by AHJ and to coordinate with CxA to find mutually convenient times for testing. Provide CxA a minimum of four days in advance of intent to schedule testing by AHJ.
    c. CxA will issue a separate report on results of testing.
    d. CxA reserves the right to require additional testing, should testing by AHJ not adequately cover all system components in all modes of operation.
5. Functional Testing is to be dedicated solely to testing of equipment and systems, and not to resolution of deficiencies. Deficiencies identified during testing process must be corrected by GC at a time other than during Functional Testing.
6. Within six days of performing functional test, CxA will issue test report with findings a list of deficiencies that must be addressed by GC or sub-Contractors.
7. Commissioning Authority shall submit a Final Report to Owner recommending acceptance or non-acceptance of individual system components as well as the systems as a whole.

K. Re-Testing And Failure To Remedy Deficiencies
1. Despite GC's best efforts to ensure systems are problem-free, it is expected that some deficiencies will be found during initial inspection of System readiness Checklist, and during initial Functional Testing; such deficiencies are expected to be minimal.
2. It is GC's responsibility to remedy identified deficiencies, both in System readiness Checklist and in Functional Testing phases of work, in a timely and thorough manner.
3. It is GC's responsibility to ensure that all deficiencies are corrected prior to requesting a re-inspection or re-test of systems and equipment. Do not request re-inspection or re-test until deficiencies are corrected.
    a. At his discretion, CxA may agree to re-testing systems or equipment where deficiencies remain which are beyond GC's control to resolve expeditiously.
    b. Typically such re-testing of incomplete systems and equipment will take place only if remaining deficiencies are minor in scope and nature, and are of such nature that they cannot be resolved in a timely manner (such as those due to difficulties in obtaining parts, or where Owner has requested a change that has delayed work, etc.)
4. CxA will carry out a second re-inspection or re-test of systems and equipment subsequent to receiving GC's request.
    a. If CxA finds deficiencies identified in initial inspection or test have not been remedied (with exception of un-resolvable deficiencies noted above), and such

remaining deficiencies are significant enough to require additional inspection or re-testing, GC will be back-charged for CxA's expenses, per Article 1.5.

3.7 DEFERRED TESTING

A. "Seasonal Commissioning" pertains to testing during peak heating or cooling seasons when HVAC equipment is operating at full-load or heavy-load conditions. Initial commissioning will be done as soon as contract work is completed, regardless of season. Seasonal Commissioning under full- or heavy-load conditions other than the current season will be handled at later time by GC and CxA.
   1. If adequate load may be artificially placed upon heating or cooling equipment, CxA, at his discretion, may perform functional testing during non-peak load periods.
   2. GC is to provide services of personnel and participate in seasonal testing process in the same manner as he would in non-seasonal testing.
   3. Until off-season commissioning can be accomplished, Owner may retain an amount from GC's payment sufficient to cover the cost of off-season testing.

B. Unforeseen Deferred Tests: If any check or test cannot be completed due to building structure, required occupancy condition, or other reason, execution of checklists and functional testing may be delayed upon approval of Owner. Tests shall be conducted in same manner as seasonal tests, as soon as possible. Services of required parties will be negotiated. Make final adjustments to Operation and Maintenance Manuals and record drawings due to unforeseen deferred tests.
   1. GC is to provide services of personnel and participate in deferred testing in the same manner as he would for normal commissioning.
   2. Until deferred testing can be accomplished, Owner may retain an amount from GC's payment sufficient to cover the cost of deferred testing.

3.8 TRAINING

A. The following requirements are in addition to operation and maintenance requirements specified elsewhere in this specifications manual. GC shall be responsible for training coordination and scheduling, and ultimately to ensure that training is completed.

B. Scheduling
   1. Organize training to fit Owner's schedule and to optimize the learning experience. Limit continuous sessions to no more than four hours, or otherwise only as approved by Owner and/or Architect.
   2. Provide an outline of the proposed training agenda for review by Owner and CxA a minimum of 10 days prior to proposed date for training session.
   3. Provide CxA a minimum 5 days advance notice of intent to carry out a training session.
   4. The CxA will not be required to attend all training sessions for building personnel, but will attend selected sessions and monitor progress and content.
   5. No training will take place prior to successful completion of Functional Testing.

C. Training Materials
   1. Develop Training Manuals to meet requirements of individual equipment specification sections.

2. Operating and Maintenance Manuals alone are NOT considered training manuals. O&M Manuals may be used as reference, but shall not be considered to meet requirements for training materials.
3. Develop a detailed outline showing how training program will be organized, including classroom and hands-on training as required by individual specifications sections.
4. Provide with training materials, a quick-reference "how-to" index which will allow operators to easily access information included in Training Manuals and/or O&M Manuals. This reference will include, as a minimum; routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions.
5. Refer to individual equipment or system specifications for minimum material to be covered as part of the training program.

D. Documentation
1. All training sessions are to be fully documented. Document:
   a. Basic information on training session (name of system, time, date, and location of training, name of presenter, length of training session, etc.).
   b. Names of persons who attended the training session (provide a sign-in sheet).
   c. Signature from authorized Owner's representative indicating that training took place and was satisfactory.
2. Provide CxA copy of sign-in sheet with training session documentation.

3.9 O&M MANUALS

A. Provide operation and maintenance manuals as specified in section 017700 Closeout Submittals, and as outlined in individual sections of Divisions 22, 23 and 26.

B. Provide CxA with a single copy of Operation and Maintenance Manuals for review. CxA's copy of O&M manuals shall be submitted through Architect.

C. CxA shall review O&M Manuals and submit comments through the Architect.

3.10 SYSTEMS TO BE COMMISSIONED

A. Refer to commissioning specifications sections in Related Sections, including the following:
1. 230100 - COMMISSIONING OF MECHANICAL SYSTEMS: HVAC and Controls.
2. 260100 - COMMISSIONING OF ELECTRICAL SYSTEMS: Lighting and Lighting Controls.

END OF SECTION 01913

ITEM 100
PREPARING RIGHT OF WAY

100.1. Description. Prepare the right of way and designated easements for construction operations by removing and disposing of all obstructions when removal of such obstructions is not specifically shown on the plans to be paid by other Items.

100.2. Construction. Protect designated features on the right of way and prune trees and shrubs as directed. Do not park equipment, service equipment, store materials, or disturb the root area under the branches of trees designated for preservation. When shown on the plans, treat cuts on trees with an approved tree wound dressing within 20 min. of making a pruning cut or otherwise causing damage to the tree. Follow all local and state regulations when burning. If burning of brush is approved, pile and burn at approved locations. When working in state or national forests or parks, coordinate work with state and federal authorities. Testing, removal, and disposal of hazardous materials will be in accordance with Article 6.10, "Hazardous Materials," Clear areas shown on the plans of all obstructions, except those landscape features that are to be preserved. Such obstructions include but are not limited to remains of houses and other structures, foundations, floor slabs, concrete, brick, lumber, plaster, septic tank drain fields, basements, abandoned utility pipes or conduits, equipment, fences, retaining walls, and other items as specified on the plans. Remove vegetation and other landscape features not designated for preservation, curb and gutter, driveways, paved parking areas, miscellaneous stone, sidewalks, drainage structures, manholes, inlets, abandoned railroad tracks, scrap iron, and debris, whether above or below ground, Removal of live utility facilities is not included in this Item. Remove culverts, storm sewers, manholes, and inlets in proper sequence to maintain traffic and drainage.

In areas receiving embankment, remove obstructions not designated for preservation to 2 ft. below natural ground. In areas to be excavated, remove obstructions to 2 ft. below the excavation level. In all other areas, remove obstructions to 1 ft. below natural ground. When allowed by the plans or directed, cut trees and stumps off to ground level. Plug the remaining ends of abandoned underground structures over 3 in. in diameter with concrete to form a tight closure. Backfill, compact, and restore areas where obstructions have been removed, unless otherwise directed. Use approved material for backfilling. Dispose of wells in accordance with Item 103, "Disposal of Wells."

Accept ownership, unless otherwise directed, and dispose of removed materials and debris at locations off the right of way in accordance with local, state, and federal requirements.

ITEM 110

EXCAVATION

110.1. Description. Excavate areas as shown on the plans or as directed. Remove materials encountered to the lines, grades, and typical sections shown on the plans and cross-sections.

110.2. Construction. Accept ownership of unsuitable or excess material and dispose *of* material in accordance with local, state, and federal regulations at locations outside the right of way.
Maintain drainage in the excavated area to avoid damage to the roadway section. Correct any damage to the subgrade caused by weather, at no additional cost to the Department,
Shape slopes to avoid loosening material below or outside the proposed grades. Remove and dispose of slides as directed.

A. **Rock Cuts.** Excavate to finish subgrade. Manipulate and compact subgrade in accordance with Article 132.3.D, "Compaction Methods," unless excavation is to clean homogenous rock at finish subgrade elevation. If excavation extends below finish subgrade, use approved embankment material compacted in accordance with Article 132.3.D to replace undercut material at no additional cost.

B. **Earth Cuts.** Excavate to finish subgrade. In areas where base or pavement structure will be placed on subgrade, scarify subgrade to a uniform depth at least 6 in. below finish subgrade elevation. Manipulate and compact subgrade in accordance with Article 132.3.D, "Compaction Methods."

If unsuitable material is encountered below subgrade elevations, take corrective measures as directed. Drying required deeper than 6 in. below subgrade elevation will be paid for in accordance with
Article 9.4, "Payment for Extra Work." Excavation and replacement of unsuitable material below subgrade elevations will be performed and paid for in accordance with the applicable bid items. However, if Item 132, "Embankment," is not included in the Contract, payment for replacement of unsuitable material will be paid for in accordance with Article 9.4.

C. **Subgrade Tolerances.** For turnkey construction, excavate to within 112 in. in cross-section and 112 in. in 16 ft. measured longitudinally. For staged construction, excavate to within 0.1 ft. in cross-section and 0.1 ft. in 16 ft. measured longitudinally.

ITEM 132
EMBANKMENT

132.1. Description. Furnish, place, and compact materials for construction of roadways, embankments, levees, dikes, or any designated section of the roadway where additional material is required.
132.2. Materials. Furnish approved material capable of forming a stable embankment from required excavation in the areas shown on the plans or from sources outside the right of way. Provide 1 or more of the following types as shown on the plans:

• Type A. Granular material that is free from vegetation or other objectionable material and meets the requirements of Table 1.

Table 1
Testing Requirements

Property	**Test Method**	**Specification Limit**
Liquid limit	Tex-104-E	45
Plasticity index (PI)	Tex-106-E	15
Bar linear shrinkage	Tex-107-E	> 2

The Linear Shrinkage test only needs to be performed as indicated in Tex-104-E,

- **Type B.** Materials such as rock, loam, clay, or other approved materials.
- **Type** C. Material meeting the specification requirements shown on the plans.
- **Type 11** Material from required excavation areas shown on the plans.

Retaining wall backfill material must meet the requirements of the pertinent retaining wall Items,

132.3. Construction. Meet the requirements of item 7, "Legal Relations and Responsibilities to the Public," when off right of way sources are used. To allow for required testing, notify the Engineer before opening a material source. Complete preparation of the right of way, in accordance with Item 100, "Preparing Right of Way," for areas to receive embankment.

Backfill tree-stump holes or other minor excavations with approved material and tamp. Restore the ground surface, including any material disked loose or washed out, to its original slope. Compact the ground surface by sprinkling in accordance with Item 204, "Sprinkling," and by rolling using equipment complying with Item 210, "Rolling," when directed.

Scarify and loosen the unpaved surface areas, except rock, to a depth of at least 6 in., unless otherwise shown on the plans. Bench slopes before placing material. Begin placement of material at the toe of slopes. Do not place trees, stumps, roots, vegetation, or other objectionable material in the embankment. Simultaneously recompact scarified material with the placed embankment material. Do not exceed the layer depth specified in Section 132.3.D, "Compaction Methods."

Construct embankments to the grade and sections shown on the plans. Construct the embankment in layers approximately parallel to the finished grade for the full width of the individual roadway cross sections, unless otherwise shown on the plans. Ensure that each section of the embankment conforms to the detailed sections or slopes. Maintain the finished section, density, and grade until the project is accepted.

A. **Earth Embankments.** Earth embankment is mainly composed of material other than rock, Construct embankments in successive layers, evenly distributing materials in lengths suited for sprinkling and rolling.

B. Obtain approval to incorporate rock and broken concrete produced by the construction project in the lower layers of the embankment. When the size of approved rock or broken concrete exceeds the layer thickness requirements in Section 132.3.D, "Compaction Methods," place the rock and concrete outside the limits of the completed roadbed. Cut and remove all exposed reinforcing steel from the broken concrete.

Move the material dumped in piles or windrows by blading or by similar methods and incorporate it into uniform layers. Featheredge or mix abutting layers of dissimilar material for at least 100 d. to ensure there are no abrupt changes in the material. Break down clods or lumps of material and mix embankment until a uniform material is attained.

Apply water free of industrial wastes and other objectionable matter to achieve the uniform moisture content specified for compaction.

When ordinary compaction is specified, roll and sprinkle each embankment layer in accordance with Section 132.3.D.1, "Ordinary Compaction." When density control is specified, compact the layer to the required density in accordance with Section 132.3.D.2, "Density Control."

B. **Rock Embankments.** Rock embankment is mainly composed of rock. Construct rock embankments in successive layers for the full width of the roadway cross-section with a depth of 18 in. or less. Increase the layer depth for large rock sizes as approved. Do not exceed a depth of 2-112 ft. in any case. Fill voids created by the large stone matrix with smaller stones during the placement and filling operations.
Ensure the depth of the embankment layer is greater than the maximum dimension of any rock. Do not place rock greater than 2 ft. in its maximum dimension, unless otherwise approved. Construct the final layer with graded material so that the density and uniformity is in accordance with Section 132.3.D, "Compaction Methods." Break up exposed oversized material as approved.

When ordinary compaction is specified, roll and sprinkle each embankment layer in accordance with Section 132,3.D.1, "Ordinary Compaction." When density control is specified, compact each layer to

the required density in accordance with Section 132.3.D.2, "Density Control." When directed, proof-roll each rock layer where density testing is not possible, in accordance with Item 216, "Proof Rolling," to ensure proper compaction.

C. **Embankments Adjacent to Culverts and Bridges.** Compact embankments adjacent to culverts and bridges in accordance with Item 400, "Excavation and Backfill for Structures,"
D. **Compaction Methods.** Begin rolling longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least 1/2 the width of the roller, On super elevated curves, begin rolling at the lower side and progress toward the high side. Alternate roller trips to attain slightly different lengths. Compact embankments in accordance with one of the following methods as shown on the plans:

1. **Ordinary Compaction.** Use approved rolling equipment complying with Item 210, "Rolling," to compact each layer. The plans or the Engineer may require specific equipment. Do not allow the loose depth of any layer to exceed 8 in,, unless otherwise approved. Before and during rolling operations, bring each layer to the moisture content directed. Compact each layer until there is no evidence of further consolidation. Maintain a level layer to ensure uniform compaction. If the required stability or finish is lost for any reason, recompact and refinish the subgrade at no additional expense to the Department.
2. **Density Control.** Compact each layer to the required density using equipment complying with Item 210, "Rolling," Determine the maximum lift thickness based on the ability of the compacting operation and equipment to meet the required density. Do not exceed layer thickness of 16 in, loose or 12 in. compacted material, unless otherwise approved. Maintain a level layer to ensure uniform compaction.
The Engineer will use Tex-114-E to determine the maximum dry density (D_a) and optimum moisture content (W_{opt}). Meet the requirements for field density and moisture content in Table 2, unless otherwise shown on the plans.

Table 2
Field Density Control Requirements

Description	Density'	Moisture Content'
	Tex-115-E	
PI 5 15	98% D_a	
15 < PI < 35	98% Da and < 102% D_a	
P1>35	z 95% DE, and <_ 100% D_a	Wopt

Each layer is subject to testing by the Engineer for density and moisture content. During compaction, the moisture content of the soil should not exceed the value shown on the moisture-density curve, above optimum, required to achieve

- 98% dry density for soils with a PI greater than 15 but less than or equal to 35 or
- 95% dry density for soils with PI greater than 35.

When required, remove small areas of the layer to allow for density tests. Replace the removed material and recompact at no additional expense to the Department. Proof-roll in accordance with Item 216, "Proof Rolling," when shown on the plans or as directed, Correct soft spots as directed.

E. **Maintenance of Moisture and Reworking.** Maintain the density and moisture content once all requirements in Table 2 are met. For soils with a PI greater than 15, maintain the moisture content no lower than 4 percentage points below optimum. Rework the material to obtain the specified compaction when the material loses the required stability, density, moisture, or finish. Alter the compaction methods and procedures on subsequent work to obtain specified density as directed.

F. Acceptance Criteria.

1. Grade Tolerances.

a. **Staged Construction.** Grade to within 0,1 ft. in the cross-section and 0.1 ft. in 16 ft. measured longitudinally,

b. **Turnkey Construction.** Grade to within 112 in. in the cross-section and 112 in. in 16 ft, measured longitudinally.

2. **Gradation Tolerances.** When gradation requirements are shown on the plans, material is acceptable when not more than 1 of the 5 most recent gradation tests is outside the specified limits on any individual sieve by more than 5 percentage points.

3. **Density Tolerances.** Compaction work is acceptable when not more than 1 of the 5 most recent density tests is outside the specified density limits, and no test is outside the limits by more than 3 lb. per cubic foot.

4. **Plasticity Tolerances.** Material is acceptable when not more than 1 of the 5 most recent PI tests is outside the specified limit by no more than 2 points.

ITEM 247
FLEXIBLE BASE

247.1. Description. Construct a foundation course composed of flexible base.

247.2. Materials. Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications, Notify the Engineer of the proposed material sources and of changes to material sources, The Engineer may sample and test project materials at any time before compaction throughout the duration of the project to assure specification compliance. Use Tex-100-E material definitions.

A. Aggregate. Furnish aggregate of the type and grade shown on the plans and conforming to the requirements of Table 1. Each source must meet Table 1 requirements for liquid limit, plasticity index, and wet ball mill for the grade specified. Do not use additives such as but not limited to lime, cement, or fly ash to modify aggregates to meet the requirements of Table 1, unless shown on the plans.

1. Material Tolerances. The Engineer may accept material if no more than 1 of the 5 most recent gradation tests has an individual sieve outside the specified limits of the gradation.

When target grading is required by the plans, no single failing test may exceed the master grading by more than 5 percentage points on sieves No. 4 and larger or 3 percentage points on sieves smaller than No. 4.

The Engineer may accept material if no more than 1 of the 5 most recent plasticity index tests is outside the specified limit, No single failing test may exceed the allowable limit by more than 2 points.

2. Material Types. Do not use fillers or binders unless approved. Furnish the type specified on the plans in accordance with the following:

a. **Type** A. Crushed stone produced and graded from oversize quarried aggregate that originates from a single, naturally occurring source. Do not use gravel or multiple sources.

b. **Type B.** Crushed or uncrushed gravel. Blending of 2 or more sources is allowed.

c. **Type C.** Crushed gravel with a minimum of 60% of the particles retained on a No. 4 sieve with 2 or more crushed faces as determined by Tex-460-A, Part I. Blending of 2 or more sources is allowed.

d. **Type D.** Type A material or crushed concrete. Crushed concrete containing gravel will be considered Type D material. Crushed concrete must meet the requirements in Section 247,2,A.3.b, "Recycled Material (Including Crushed Concrete) Requirements," and be managed in a way to provide for uniform quality. The Engineer may require separate dedicated stockpiles in order to verify compliance.

e. **Type E.** As shown on the plans.

3. Recycled Material. Recycled asphalt pavement (RAP) and other recycled materials may be used when shown on the plans. Request approval to blend 2 or more sources of recycled materials.

a. Limits on Percentage. When RAP is allowed, do not exceed 20% RAP by weight unless otherwise shown on the plans. The percentage limitations for other recycled materials will be as shown on the plans.

b. Recycled Material (Including Crushed Concrete) Requirements.

(1) **Contractor Furnished Recycled Materials.** When the Contractor furnishes the recycled materials, including crushed concrete, the final product will be subject to the requirements of Table 1 for the grade specified. Certify compliance with DMS-11000, "Evaluating and Using Nonhazardous Recyclable Materials Guidelines," for Contractor furnished recycled materials, In addition, recycled materials must be free from reinforcing steel and other objectionable material and have at most 1.5% deleterious material when tested in accordance with Tex-413-A. For RAP, do not exceed a maximum percent loss from decantation of 5.0% when tested in accordance with Tex-406-A. Test RAP without removing the asphalt.

(2) **Department Furnished Required Recycled Materials.** When the Department furnishes and requires the use of recycled materials, unless otherwise shown on the plans:

· Department required recycled material will not be subject to the requirements in Table 1,

- Contractor furnished materials are subject to the requirements in Table 1 and this Item,
  the final product, blended, will be subject to the requirements in Table 1, and
  for final product, unblended (100% Department furnished required recycled material), the liquid limit,

plasticity index, wet ball mill, classification, and compressive strength is waived,

Crush Department-furnished RAP so that 100% passes the 2 in, sieve. The Contractor is responsible for uniformly blending to meet the percentage required.

(3) **Department Furnished and Allowed Recycled Materials.** When the Department furnishes and allows the use of recycled materials or allows the Contractor to furnish recycled materials, the final blended product is subject to the requirements of Table 1 and the plans.

c. Recycled Material Sources. Department-owned recycled material is available to the Contractor only when shown on the plans. Return unused Department-owned recycled materials to the Department stockpile location designated by the Engineer unless otherwise shown on the plans.

The use of Contractor-owned recycled materials is allowed when shown on the plans. Contractor-owned surplus recycled materials remain the property of the Contractor. Remove Contractor-owned recycled materials from the project and dispose of them in accordance with federal, state, and local regulations before project acceptance. Do not intermingle Contractor-owned recycled material with Department-owned recycled material unless approved by the Engineer.

B. **Water.** Furnish water free of industrial wastes and other objectionable matter.
C. Material Sources. When non-commercial sources are used, expose the vertical faces of all strata of material proposed for use. Secure and process the material by successive vertical cuts extending through all exposed strata, when directed.

247.3. Equipment. Provide machinery, tools, and equipment necessary for proper execution of the work, Provide rollers in accordance with Item 210, "Rolling," Provide proof rollers in accordance with Item 216, "Proof Rolling," when required,

247.4. Construction. Construct each layer uniformly, free of loose or segregated areas, and with the required density and moisture content. Provide a smooth surface that conforms to the typical sections, lines, and grades shown on the plans or as directed.

Stockpile base material temporarily at an approved location before delivery to the roadway. Build stockpiles in layers no greater than 2 ft, thick. Stockpiles must have a total height between 10 and 16 ft. unless otherwise shown on the plans. After construction and acceptance of the stockpile, loading from the stockpile for delivery is allowed. Load by making successive vertical cuts through the entire depth of the stockpile.

Do not add or remove material from temporary stockpiles that require sampling and testing before delivery unless otherwise approved. Charges for additional sampling and testing required as a result of adding or removing material will be deducted from the Contractor's estimates.

Haul approved flexible base in clean trucks. Deliver the required quantity to each 100-ft. station or designated stockpile site as shown on the plans. Prepare stockpile sites as directed. When delivery is to the 100-ft. station, manipulate in accordance with the applicable Items.

A, Preparation of Subgrade or Existing Base. Remove or scarify existing asphalt concrete pavement in accordance with Item 105, "Removing Stabilized Base and Asphalt Pavement," when shown on the plans or as directed. Shape the sub grade or existing base to conform to the typical sections shown on the plans or as directed.

When new base is required to be mixed with existing base, deliver, place, and spread the new flexible base in the required amount per station. Manipulate and thoroughly mix the new base with existing material to provide a uniform mixture to the specified depth before shaping.

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When shown on the plans or directed, proof roll the roadbed in accordance with Item 216, "Proof Rolling," before pulverizing or scarifying. Correct soft spots as directed.

B. **Placing.** Spread and shape flexible base into a uniform layer with an approved spreader the same day as delivered unless otherwise approved. Construct layers to the thickness shown on the plans. Maintain the shape of the course. Control dust by sprinkling, as directed. Correct or replace segregated areas as directed, at no additional expense to the Department.

Place successive base courses and finish courses using the same construction methods required for the first course.

C. **Compaction.** Compact using density control unless otherwise shown on the plans. Multiple lifts are permitted when shown on the plans or approved. Bring each layer to the moisture content directed. When necessary, sprinkle the material in accordance with Item 204, "Sprinkling."
Begin rolling longitudinally at the sides and proceed towards the center, overlapping on successive trips by at least 112 the width of the roller unit. On superelevated curves, begin rolling at the low side and progress toward the high side. Offset alternate trips of the roller. Operate rollers at a speed between 2 and 6 mph as directed.

Rework, recompact, and refinish material that fails to meet or that loses required moisture, density, stability, or finish before the next course is placed or the project is accepted. Continue work until specification requirements are met, Perform the work at no additional expense to the Department.

1. **Ordinary Compaction.** Roll with approved compaction equipment as directed. Correct irregularities, depressions, and weak spots immediately by scarifying the areas affected, adding or removing approved material as required, reshaping, and recompacting.

2. Density Control. Compact to at least 100% of the maximum density determined by Tex-113-E unless otherwise shown on the plans. Determine the moisture content of the material at the beginning and during compaction in accordance with Tex-103-E.

The Engineer will determine roadway density of completed sections in accordance with Tex-115-E. The Engineer may accept the section if no more than 1 of the 5 most recent density tests is below the specified density and the failing test is no more than 3 pef below the specified density.

D. **Finishing,** After completing compaction, clip, skin, or tight-blade the surface with a maintainer or subgrade trimmer to a depth of approximately 114 in. Remove loosened material and dispose of it at an approved location. Seal the clipped surface immediately by rolling with a pneumatic tire roller until a smooth surface is attained. Add small increments of water as needed during rolling. Shape and maintain the course and surface in conformity with the typical sections, lines, and grades as shown on the plans or as directed.
In areas where surfacing is to be placed, correct grade deviations greater than 114 in. in 16 ft. measured longitudinally or greater than 114 in. over the entire width of the cross-section. Correct by loosening, adding, or removing material. Reshape and recompact in accordance with Section 247.4.C, "Compaction."

E. **Curing.** Cure the finished section until the moisture content is at least 2 percentage points below optimum or as directed before applying the next successive course or prime coat.

ITEM 260
LIME TREATMENT (ROAD-MIXED)

260.1. Description. Mix and compact lime, water, and subgrade or base (with or without asphaltic concrete pavement) in the roadway.

260.2. Materials. Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications. Notify the Engineer of the proposed material sources and of changes to material sources. Obtain verification from the Engineer that the specification requirements are met before using the sources. The Engineer may sample and test project materials at any time before compaction. Use Tex-100-E for material definitions.

A. **Lime.** Furnish lime that meets the requirements of DMS-6350 "Lime and Lime Slurry," and DMS-6330, "Lime Sources Prequalification of Hydrated Lime and Quicklime," Use hydrated lime, commercial lime slurry, or quicklime, as shown on the plans. When furnishing quicklime, provide it in bulk.
B. **Flexible Base.** Furnish base material that meets the requirements of Item 247, "Flexible Base," for the type and grade shown on the plans, before the addition of lime.
C. **Water.** Furnish water free of industrial wastes and other objectionable material.
D. **Asphalt.** When asphalt or emulsion is permitted for curing purposes, furnish materials that meet the requirements of Item 300, "Asphalts, Oils, and Emulsions," as shown on the plans or as directed.
E. **Mix Design.** The Engineer will determine the target lime content and optimum moisture content in accordance with Tex-121-E or prior experience with the project materials. The Contractor may propose a mix design developed in accordance with Tex-121-E. The Engineer will use Tex-12I-E to verify the Contractor's proposed mix design before acceptance. Reimburse the Department for subsequent mix designs or partial designs necessitated by changes in the material or requests by the Contractor. When treating existing materials, limit the amount of asphalt concrete pavement to no more than 50% of the mix unless otherwise shown on the plans or directed.

260.3. Equipment. Provide machinery, tools, and equipment necessary for proper execution of the work. Provide rollers in accordance with Item 210, "Rolling." Provide proof rollers in accordance with Item 216, "Proof Rolling," when required.

A. **Storage** Facility. Store quicklime and dry hydrated lime in closed, weatherproof containers.
B. **Slurry Equipment.** Use slurry tanks equipped with agitation devices to slurry hydrated lime or quicklime on the project or other approved location. The Engineer may approve other slurrying methods.
Provide a pump for agitating the slurry when the distributor truck is not equipped with an agitator. Equip the distributor truck with a sampling device in accordance with Tex-600-J, Part I, when using commercial lime slurry.

C. **Pulverization Equipment.** Provide pulverization equipment that:
- cuts and pulverizes material uniformly to the proper depth with cutters that plane to a uniform surface over the entire width of the cut,
- provides a visible indication of the depth of cut at all times, and
- uniformly mixes the materials.

260.4. Construction. Construct each layer uniformly, free of loose or segregated areas, and with the required density and moisture content, Provide a smooth surface that conforms to the typical sections, lines, and grades shown on the plans or as directed.

A. **Preparation of Subgrade or Existing Base for Treatment.** Before treating, remove existing asphalt concrete pavement in accordance with Item 105, "Removing Stabilized Base and Asphalt Pavement," when shown on the plans or as directed. Shape existing material in accordance with applicable bid items to conform to typical sections shown on the plans and as directed.

When shown on the plans or directed, proof roll the roadbed in accordance with Item 216, "Proof Rolling," before pulverizing or scarifying existing material. Correct soft spots as directed.

When new base material is required to be mixed with existing base, deliver, place, and spread the new material in the required amount per station. Manipulate and thoroughly mix new base with existing material to provide a uniform mixture to the specified depth before shaping.

B. **Pulverization.** Pulverize or scarify existing material after shaping so that 100% passes a 2-1.12-in. sieve. If the material cannot be uniformly processed to the required depth in a single pass, excavate and windrow the material to expose a secondary grade to achieve processing to plan depth.

C. Application of Lime. Uniformly apply lime using dry or slurry placement as shown on the plans or as directed, Add lime at the percentage determined in Section 260.2.E, "Mix Design," Apply lime only on an area where mixing can be completed during the same working day.

Start lime application only when the air temperature is at least 35°F and rising or is at least 40°F. The temperature will be taken in the shade and away from artificial heat, Suspend application when the Engineer determines that weather conditions are unsuitable.

Minimize dust and scattering of lime by wind, Do not apply lime when wind conditions, in the opinion of the Engineer, cause blowing lime to become dangerous to traffic or objectionable to adjacent property owners. When pebble grade quicklime is placed dry, mix the material and lime thoroughly at the time of lime application, Use of quicklime can be dangerous. Inform users of the recommended precautions for handling and storage.

1. **Dry Placement.** Before applying lime, bring the prepared roadway to approximately optimum moisture content. When necessary, sprinkle in accordance with Item 204, "Sprinkling." Distribute the required quantity of hydrated lime or pebble grade quicklime with approved equipment. Only hydrated lime may be distributed by bag. Do not use a motor grader to spread hydrated lime.

2. **Slurry Placement.** Provide slurry free of objectionable materials, at or above the approved minimum dry solids content, and with a uniform consistency that will allow ease of handling and uniform application, Deliver commercial lime slurry to the jobsite or prepare lime slurry at the jobsite or other approved location by using hydrated lime or quicklime, as specified.

Distribute slurry uniformly by making successive passes over a measured section of roadway until the specified lime content is reached. Uniformly spread the residue from quicklime slurry over the length of the roadway being processed, unless otherwise directed.

D. Mixing. Begin mixing within 6 hours of application of lime. Hydrated lime exposed to the open air for 6 hours or more between application and mixing, or that experiences excessive loss due to washing or blowing, will not be accepted for payment.

Thoroughly mix the material and lime using approved equipment. Allow the mixture to mellow for 1 to 4 days, as directed, When pebble grade quicklime is used, allow the mixture to mellow for 2 to 4 days, as directed. Sprinkle the treated materials during the mixing and mellowing operation, as directed, to achieve adequate hydration and proper moisture content. After mellowing, resume mixing until a homogeneous, friable mixture is obtained.

After mixing, the Engineer will sample the mixture at roadway moisture and test in accordance with Tex-101-E, Part III, to determine compliance with the gradation requirements in Table 1.

Table 1
Gradation Requirements (Minimum % Passing)

Sieve Size	Base	Subgrade
1-314 in,	100	100
314 in.	85	85
No. 4	-	60

E. Compaction. Compact the mixture using density control, unless otherwise shown on the plans. Multiple lifts are permitted when shown on the plans or approved. Bring each layer to the moisture content directed. When necessary, sprinkle the treated material in accordance with Item 204, "Sprinkling." Determine the moisture content of the mixture at the beginning and during compaction in accordance with Tex-103-E.

Begin rolling longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least one-half the width of the roller unit. On super elevated curves, begin rolling at the low side and progress toward the high side. Offset alternate trips of the roller. Operate rollers at a speed between 2 and 6 MPH, as directed.

Rework, recompact, and refinish material that fails to meet or that loses required moisture, density, stability, or finish before the next course is placed or the project is accepted. Continue work until specification requirements are met. Rework in accordance with Section 260.4.F, "Reworking a Section." Perform the work at no additional expense to the Department.

1. Ordinary Compaction. Roll with approved compaction equipment, as directed. Correct irregularities, depressions, and weak spots immediately by scarifying the areas affected, adding or removing treated material as required, reshaping, and recompacting.

2. Density Control. The Engineer will determine roadway density of completed sections in accordance with Tex-115-E. The Engineer may accept the section if no more than 1 of the 5 most recent density tests is below the specified density and the failing test is no more than 3 pcf below the specified density.

a. Subgrade. Compact to at least 95% of the maximum density determined in accordance with Tex-121-E, unless otherwise shown on the plans.
b. Base, Compact the bottom course to at least 95% of the maximum density determined in accordance with Tex-121-E, unless otherwise shown on the plans. Compact subsequent courses treated under this Item to at least 98% of the maximum density determined in accordance with Tex-121-E, unless otherwise shown on the plans.

F. Reworking a Section. When a section is reworked within 72 hours after completion of compaction, rework the section to provide the required density. When a section is reworked more than 72 hr. after completion of compaction, add additional lime at 25% of the percentage determined in Section 260,2.E, "Mix Design," Reworking includes loosening, adding material or removing unacceptable material if necessary, mixing as directed, compacting, and finishing. When density control is specified, determine a new maximum density of the reworked material in accordance with Tex-121-E, and compact to at least 95% of this density.

G. Finishing. Immediately after completing compaction of the final course, clip, skin, or tight-blade the surface of the lime-treated material with a maintainer or subgrade trimmer to a depth of approximately 114 in. Remove loosened material and dispose of at an approved location. Roll the clipped surface immediately with a pneumatic tire roller until a smooth surface is attained. Add small amounts of water as needed during rolling. Shape and maintain the course and surface in conformity with the typical sections, lines, and grades shown on the plans or as directed.

Finish grade of constructed subgrade in accordance with
Section 132.3.F.1, "Grade Tolerances." Finish grade of constructed base in accordance with Section 247.4.D, "Finishing."

H. Curing. Cure for the minimum number of days shown in Table 2 by sprinkling in accordance with Item 204, "Sprinkling," or by applying an asphalt material at a rate of 0.05 to 0.20 gal. per square yard as directed, Maintain moisture during curing, Upon completion of curing, maintain the moisture content in accordance with Article 132.3.E, "Maintenance of Moisture and Reworking" for subgrade and Article 247.4,E, "Curing" for bases prior to placing subsequent courses. Do not allow equipment on the finished course during curing except as required for sprinkling, unless otherwise approved. Apply seals or additional courses within 14 calendar days of final compaction.

Table 2
Minimum Curing Requirements Before Placing Subsequent Courses

Untreated Material	**Curing (Days)**
PIS35	2
P1>35	5

I. Subject to the approval of the Engineer. Proof rolling may be required as an indicator of adequate curing.

- Quicklime (Dry), or
- Quicklime (Slurry).

This price is full compensation for materials, delivery, equipment, labor, tools, and incidentals.
Lime used for reworking a section in accordance with Section 260.4.F, "Reworking a Section," will not be paid for directly but will be subsidiary to this Item.

B. Lime Treatment. Lime treatment will be paid for at the unit price bid for "Lime Treatment (Existing Material)," "Lime Treatment (New Base)," or "Lime Treatment (Mixing Existing Material and New Base)," for the depth specified. No payment will be made for thickness or width exceeding that shown on the plans. This price is full compensation for shaping existing material, loosening, mixing, pulverizing, providing lime, spreading, applying lime, compacting, finishing, curing, curing materials, blading, shaping and maintaining, replacing, disposing of loosened materials, processing, hauling, preparing secondary subgrade, water, equipment, labor, tools, and incidentals.

ITEM 310
PRIME COAT

310.1. Description. Prepare and treat existing or newly constructed surface with a bituminous material. Apply blotter material as required.

310.2. Materials.

A. Bituminous. Use material of the type and grade shown on the plans in accordance with Item 300, "Asphalts, Oils, and Emulsions."

B. Blotter. Unless otherwise shown on the plans or approved, use either base course sweepings obtained from cleaning the base or native sand as blotter materials.

310.3. Equipment. Provide applicable equipment in accordance with Article 316.3, "Equipment."

310.4. Construction.

A. General. Apply the mixture when the air temperature is 60°F and above, or above 50°F and rising. Measure the air temperature in the shade away from artificial heat. The Engineer will determine when weather conditions are suitable for application.

Do not permit traffic; hauling, or placement of subsequent courses over freshly constructed prime coats. Maintain the primed surface until placement of subsequent courses or acceptance of the work.

B. Surface Preparation. Prepare the surface by sweeping or other approved methods. When directed, before applying bituminous material, lightly sprinkle the surface with water to control dust and ensure absorption.

C. Application.

1 Bituminous. The Engineer will select the application temperature within the limits recommended in Item 300, "Asphalts, Oils, and Emulsions." Apply material within 15°F of the selected temperature.

Distribute the material smoothly and evenly at the rate selected by the Engineer. When directed, roll the freshly applied prime coat with a pneumatic-tire roller to ensure penetration.

2. Blotter. Spread blotter material before allowing traffic to use a primed surface. When "Prime Coat and “Blotter” is shown on the plans as a bid item, apply blotter material to primed surface at the rate shown in the plans or as directed. When "Prime Coat" is shown on the plans as a bid item, apply blotter to spot locations or as directed to accommodate traffic movement through the work area. Remove blotter material before placing the surface. Dispose of blotter material according to applicable state and federal requirements.

ITEM 340
DENSE-GRADED HOT-MIX ASPHALT (METHOD)

340.1. Description. Construct a pavement layer composed of a compacted, dense-graded mixture of aggregate and asphalt binder mixed hot in a mixing plant,
340.2. Materials. Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

Notify the Engineer of all material sources. Notify the Engineer before changing any material source or formulation. When the Contractor makes a source or formulation change, the Engineer will verify that the requirements of this Item are mat and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time during the project to verify compliance.

A. Aggregate. Furnish aggregates from sources that conform to the requirements shown in Table 1, and as specified in this Section, unless otherwise shown on the plans. Provide aggregate stockpiles that meet the definition in this Section for either coarse aggregate or fine aggregate. When reclaimed asphalt pavement (RAP) is allowed by plan note, provide RAP stockpiles in accordance with this Section. Aggregate from RAP is not required to meet Table 1 requirements unless otherwise shown on the plans. Supply mechanically crushed gravel or stone aggregates that meet the definitions in Tex-100-E. The Engineer will designate the plant or the quarry as the sampling location. Samples must be from materials produced for the project. The Engineer will establish the surface aggregate classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests.
Perform all other aggregate quality tests listed in Table 1. Document all test results on the mixture design report. The Engineer may perform tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately. Determine aggregate gradations for mixture design and production testing based on the washed sieve analysis given in Tex-200-F, Part II. Do not add material to an approved stockpile from sources that do not meet the aggregate quality requirements of the Department's *Bituminous Rated Source Quality Catalog* (BRSQC) unless otherwise approved.

1. Coarse Aggregate. Coarse aggregate stockpiles must have no more than 20% material passing the No, 8 sieve. Provide aggregates from sources listed in the BRSQC. Provide aggregate from nonlisted sources only when tested by the Engineer and approved before use. Allow 30 calendar days for the Engineer to sample, test, and report results for nonlisted sources.

Provide coarse aggregate with at least the minimum SAC shown on the plans. SAC requirements apply only to aggregates used on the surface of travel lanes, unless otherwise shown on the plans. The SAC for sources on the Department's AQMP is listed in the BRSQC.

Class B aggregate meeting all other requirements in Table 1 may be blended with a Class A aggregate in order to meet requirements for Class A materials. When blending Class A and B aggregates to meet a Class A requirement, ensure that at least 50% by weight of the material retained on the No. 4 sieve comes from the Class A aggregate source. Blend by volume if the bulk specific gravities of the Class A and B aggregates differ by more than 0.300, When blending, do not use Class C or D aggregates, For blending purposes, coarse aggregate from RAP will be considered as Class B aggregate.

2. RAP. RAP is salvaged, milled, pulverized, broken, or crushed asphalt pavement. Crush or break RAP so that 100% of the particles pass the 2-in, sieve.

RAP from either Contractor- or Department-owned sources, including RAP generated during the project, is permitted only when shown on the plans, Department-owned RAP, if allowed for use, will be available at the location shown on the plans. When RAP is used, determine asphalt content and gradation for mixture design purposes, Perform other tests on RAP when shown on the plans.

When RAP is allowed by plan note, use no more than 30% RAP in Type A or B mixtures unless otherwise shown on the plans. For all other mixtures, use no more than 20% RAP unless otherwise shown on the plans.
Do not use RAP contaminated with dirt or other objectionable materials. Do not use the RAP if the decantation value exceeds 5% and the plasticity index is greater than 8. Test the stockpiled RAP for decantation in accordance with the laboratory method given in Tex-406-A, Part I. Determine the plasticity index using Tex-106-E if the decantation value exceeds 5%. The decantation and plasticity index requirements do not apply to RAP samples with asphalt removed by extraction.

Do not intermingle Contractor-owned RAP stockpiles with Department-owned RAP stockpiles. Remove unused Contractor owned RAP material from the project site upon completion of the project, Return unused Department-owned RAP to the designated stockpile location.

3. Fine Aggregate. Fine aggregates consist of manufactured sands, screenings, and field sands. Fine aggregate stockpiles must meet the gradation requirements in Table 2. Supply fine aggregates that are free from organic impurities. The Engineer may test the fine aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. At most 15% of the total aggregate may be field sand or other uncrushed Fine aggregate. With the exception of field sand, use fine aggregate from coarse aggregate sources that meet the requirements shown in Table 1, unless otherwise approved. If 10% or more of the stockpile is retained on the No. 4 sieve, test the stockpile and verify that it meets the requirements in Table 1 for coarse aggregate angularity (Tex-460-A) and flat and elongated particles (Tex-280-F).

Table 1
Aggregate Quality Requirements

Property	Test Method	Requirement
Coarse Aggregate		
SAC	AQMP	As shown on plans
Deleterious material, %, max	Tex-217-F, Part I	1.5
Decantation, %, max	Tex-217-F, Part II	1.5
Micro-Deval abrasion, %, max	Tex-461-A	Note 1
Los Angeles abrasion, %, max	Tex-410-A	40
Magnesium sulfate soundness, 5 cycles, %, max	Tex-411-A	30[2]
Coarse aggregate angularity, 2 crushed faces, %,	Tex 460-A, Part I	85[3]
Flat and elongated particles 5:1, %, max	Tex-280-F	10
Fine Aggregate		
Linear shrinkage, %, max	Tex-107-E I	3
Combined Aggregate[4]		
Sand equivalent, %, min	Tex-203-F	45

1. Not used for acceptance purposes. Used by the Engineer as an indicator of the need for further investigation.
2. Unless otherwise shown on the plans.
3. Unless otherwise shown on the plans. Only applies to crushed gravel,
4. Aggregates, without mineral filler, RAP, or additives, combined as used in the job-mix formula (IMF).

Table 2
Gradation Requirements for Fine Aggregate

Sieve Size	% Passing by Weight or Volume
3/8'	100
#8	70-100
#200	0-30

B. Mineral Filler. Mineral filler consists of finely divided mineral matter such as agricultural lime, crusher fines, hydrated lime, cement, or fly ash. Mineral filler is allowed unless otherwise shown on the plans. Do not use more than 2% hydrated lime or cement, unless otherwise shown on the plans. The plans may require or disallow specific mineral fillers. When used, provide mineral filler that:

- is sufficiently dry, free-flowing, and free from clumps and foreign matter;
- does not exceed 3% linear shrinkage when tested in accordance with Tex-107-E; and
- meets the gradation requirements in Table 3.

Table 3
Gradation Requirements for Mineral Filler

Sieve Size	% Passing by Weight or Volume
#8	100
#200	55-100

C. Baghouse Fines. Fines collected by the baghouse or other dust-collecting equipment may be reintroduced into the mixing drum.
D, Asphalt Binder. Furnish the type and grade of performance-graded (PG) asphalt binder specified on the plans in accordance with Section 300.2.7, "Performance-Graded Binders."
E. Tack Coat. Unless otherwise shown on the plans or approved, furnish CSS-1H, SS-1H, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300, "Asphalts, Oils, and Emulsions."
Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use. If required, verify that emulsified asphalt proposed for use meets the minimum residual asphalt percentage specified in Item 300, "Asphalts, Oils, and Emulsions."

The Engineer will obtain at least 1 sample of the tack coat binder per project and test it to verify compliance with Item 300. The Engineer will obtain the sample from the asphalt distributor immediately before use.

F. Additives. When shown on the plans, use the type and rate of additive specified. Other additives that facilitate mixing or improve the quality of the mixture may be allowed when approved.
If lime or a liquid antistripping agent is used, add in accordance with Item 301, "Asphalt Antistripping Agents." Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime back into the drum.

340.3. Equipment. Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement."

340.4. Construction. Design, produce, store, transport, place, and compact the specified paving mixture in accordance with the requirements of this Item, Unless otherwise shown on the plans, provide the mix design, The Department will perform quality assurance (QA) testing. Provide quality control (QC) testing as needed to meet the requirements of this Item.

A. Mixture Design.
1. Design Requirements. Use a Level H specialist certified by a Department-approved hot-mix asphalt certification program to develop the mixture design. Have the Level II specialist sign the design documents. Unless otherwise shown on the plans, use the typical weight design example given in Tex-204-F, Part I, to design a mixture meeting the requirements listed in Tables 1 through 6. Use an approved laboratory to perform the Hamburg Wheel test and provide results with the mixture design, or provide the laboratory mixture and request that the Department perform the Hamburg Wheel test. The Construction Division maintains a list of approved laboratories, Furnish the Engineer with representative samples of all materials used in the mixture design. The Engineer will verify the mixture design. If the design cannot be verified by the Engineer, furnish another mixture design.

The Contractor may submit a new mixture design at anytime during the project, The Engineer will approve all mixture designs before the Contractor can begin production.
Provide the Engineer with a mixture design report using Department-provided software. Include the following items in the report:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- results of all applicable tests;
- the mixing and molding temperatures;
- the signature of the Level II person or persons who performed the design;
- the date the mixture design was performed, and
- a unique identification number for the mixture design.

Table 4
Master Gradation Bands (% Passing by Weight or Volume)
and Volumetric Properties

Sieve Size	A Coarse Base	B Fine Base	C Coarse Surface	D Fine Surface	F Fine Mixture
1-1/2"	980-100.0	-	-	-	_
1"	78.0-94.0	98.0-100.0	-	-	-
3/4"	64.0-85.0	84.0-98.0	95,0-100.0	-	-
1/2"	50.0-70.0	-		98.0-1000	-
3/8"	-	60.0-80.0	70.0-85.0	85.0--100,0	98.0-100.0
#4	30.0-50.0	40.0-60.0	43.0-63,0	50.0-70.0	80.0-86.0
#8	22.0-36.0	29.0-43 0	32.0-44.0	35.0-46.0	38.0-48.0
#30	8.0-23.0	13.0-28.0	14.0-28.0	15.0-29.0	12.0-27.4
#50	3.0-19,0	6.0-20.0	7.0-21.0	7.0-20.0	6.0-19.0
#200	2.0-7.0	2.0-7.0	2.0-7.0	2.0-7,0	2.0-7.0
Design VMA[F], % Minimum					
-	**12.0**	**13.0**	**14.0**	**15.0**	**16.0**
Plant-Produced 'VMA, % Minimum					
-	11.0	12.0	13.0	14.0	15.0

1. Voids in Mineral Aggregates.

Table 5
Laboratory Mixture Design Properties

Property	Test Method	Requirement
Target laboratory-molded density, %	Tex-207-F	96.0[1]
Tensile strength (dry), psi (molded to 93% ±l% density)	Tex-226-F	85-200[2]
Boil test[3]	Tex-530-C	-

1. Unless otherwise shown on the plans.
2. May exceed 200 psi when approved and may be waived when approved.
3. Used to establish baseline for comparison to production results, May be waived when approved.

Table 6
Hamburg Wheel Test Requirements

High-Temperature Binder Grade	Minimum IS of Passes[2] @ 0.5" Rut Depth, Tested @ 122°F
PG 64 or lower	10,000
PG 70	15,000
PG 76 or higher	20,000

1. Tested in accordance with Tex-242-F.
2. May be decreased or waived when shown on the plans.

B. Job-Mix Formula Approval. The job-mix formula (JMF) is the combined aggregate gradation and target asphalt percentage used to establish target values for mixture production. JMF is the original laboratory mixture design used to produce the trial batch, The Engineer and the Contractor will verify JMF based on plant-produced mixture from the trial batch unless otherwise approved. The Engineer may accept an existing mixture design previously used on a Department project and may waive the trial batch to verify JMF. If the JMF is not verified by the Engineer from the trial batch, adjust the JMF or redesign the mix and produce as many trial batches as necessary to verify the JMF.

Provide the Engineer with split samples of the mixtures and blank samples used to determine the ignition oven correction factors. The Engineer will determine the aggregate and asphalt correction factors from the ignition oven using Tex-236-F.

The Engineer will use a Texas gyratory compactor calibrated in accordance with Tex-914-F in molding production samples.

The Engineer will perform Tex-530-C and retain the tested sample for comparison purposes during production. The Engineer may waive the requirement for the boil test.

C. JMF Field Adjustments. Produce a mixture of uniform composition closely conforming to the approved IMF.

If, during initial days of production, the Contractor or Engineer determines that adjustments to the JMF are necessary to achieve the specified requirements, or to more nearly match the aggregate production, the Engineer may allow adjustment of the IMF within the tolerances of Table 7 without a laboratory redesign of the mixture.

The Engineer will adjust the asphalt content to maintain desirable laboratory density near the optimum value while achieving other mix requirements.

Table 7
Operational Tolerances

Description	Test Method	Allowable Difference from JMF Target
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	±5.0[1]
Individual % retained for sieves smaller than #8 and larger than #200		±3,0[1]
% passing the #200 sieve		±2.0[1]
Asphalt content, %	Tex-236-F	±0.3[1]
Laboratory-molded density, %	Tex-207-F	±1.0
VMA, %, min		Note 2

1. When within these tolerances, mixture production gradations may fail outside the master grading limits; however, the percent passing the #200 sieve will be considered out of tolerance when outside the master grading limits.
2. Test and verify that Table 4 requirements are met.

D. Production Operations. Perform a new trial batch when the plant or plant location is changed. The Engineer may suspend production for noncompliance with this Item. Take corrective action and obtain approval to proceed after any production suspension for noncompliance.

1. Operational Tolerances. During production, do not exceed the operational tolerances in Table 7. Stop production if testing indicates tolerances are exceeded on:

- 3 consecutive tests on any individual sieve,
- 4 consecutive tests on any of the sieves, or
- 2 consecutive tests on asphalt content.

Begin production only when test results or other information indicate, to the satisfaction of the Engineer, that the next mixture produced will be within Table 7 tolerances.

2. Storage and Heating of Materials. Do not heat the asphalt binder above the temperatures specified in Item 300, "Asphalts, Oils, and Emulsions" or outside the manufacturer's recommended values. On a daily basis, provide the Engineer with the records of asphalt binder and hot-mix asphalt discharge temperatures in accordance with Item 320, "Equipment for Asphalt Concrete Pavement." Unless otherwise approved, do not store mixture for a period long enough to affect the quality of the mixture, nor in any case longer than 12 hr.

3. Mixing and Discharge of Materials. Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not exceed 350°F. The Department will not pay for or allow placement of any mixture produced at more than 350°F. Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant.

E. Hauling Operations. Before use, clean all truck beds to ensure mixture is not contaminated. When a release agent is necessary to coat truck beds, use a release agent on the approved list maintained by the Construction Division.

F. Placement Operations. Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from pavement edges. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Offset longitudinal joints of successive courses of hot mix by at least 6 in. Place mixture so longitudinal joints on the surface course coincide with lane lines, or as directed. Ensure that all finished surfaces will drain properly, Place mixture within the compacted lift thickness shown in Table 8, unless otherwise shown on the plans or allowed.

Table 8
Compacted Lift Thickness and Required Core Height

Mixture Type	Compacted Lift Thickness	
	Minimum (in.)	Maximum (in.)
A	3.00	6.00
B	2.50	5.00
C	2.00	4.00
D	1.50	3.00
F	1.25	2.50

1. **Weather Conditions.** Place mixture when the roadway surface temperature is 60°F or higher unless otherwise approved. Measure the roadway surface temperature with a handheld infrared thermometer. Unless otherwise shown on the plans, place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable in the opinion of the Engineer.

2. **Tack** Coat. Clean the surface before placing the tack coat. Unless otherwise approved, apply tack coat uniformly at the rate directed by the Engineer. The Engineer will set the rate between 0.04 and 0.10 gal, of residual asphalt per square yard of surface area. Apply a thin, uniform tack coat to all contact surfaces of curbs, structures, and all joints. Prevent splattering of tack coat when placed adjacent to curb, gutter, and structures. Roll the tack coat with a pneumatic tire roller when directed. The Engineer may use Tex-243-F to
verify that the tack coat has adequate adhesive properties. The Engineer may suspend paving operations until there is adequate adhesion.

G. Lay-Down Operations.
1. Minimum Mixture Placement Temperatures. Use Table 9 for suggested minimum mixture placement temperatures.
2. Windrow Operations. When hot mix is placed in windrows, operate windrow pickup equipment so that substantially all the mixture deposited on the roadbed is picked up and loaded into the paver.

Table 9
Suggested Minimum Mixture Placement Temperature

High-Temperature Binder Grade	Minimum Placement Temperature (Before Entering Paver)
PG 64 or lower	260°F
PG 70	270°F
PG 76	280°F
PG 82 or higher	290°F

H. Compaction. Use air void control unless ordinary compaction control is specified on the plans, Avoid displacement of the mixture. If displacement occurs, correct to the satisfaction of the Engineer, Ensure pavement is fully compacted before allowing rollers to stand on the pavement. Unless otherwise directed, use only water or an approved release agent on rollers, tamps, and other compaction equipment. Keep diesel, gasoline, oil, grease, and other foreign matter off the mixture. Unless otherwise directed, operate vibratory rollers in static mode when not compacting, when changing directions, or when the plan depth of the pavement mat is less than 1-½ in.

Use tamps to thoroughly compact the edges of the pavement along curbs, headers, and similar structures and in locations that will not allow thorough compaction with the rollers. The Engineer may require rolling with a trench roller on widened areas, in trenches, and in other limited areas.

Allow the compacted pavement to cool to 160°F or lower before opening to traffic unless otherwise directed. When directed, sprinkle the finished mat with water or limewater to expedite opening the roadway to traffic.

1. Air Void Control. Compact dense-graded hot-mix asphalt to contain from 5% to 9% in-place air voids. Do not increase the asphalt content of the mixture to reduce pavement air voids.

a. Rollers. Furnish the type, size, and number or rollers required for compaction, as approved. Use a pneumatic-tire roller to seal the surface, unless otherwise shown on the plans. Use additional rollers as required to remove any roller marks.

b. Air Void Determination. Unless otherwise shown on the plans, obtain 2 roadway specimens at each location selected by the Engineer for in-place air void determination. The Engineer will measure air voids in accordance with Tex-207-F and Tex-227-F. Before drying to a constant weight, cores may be predried using a Corelok or similar vacuum device to remove excess moisture. The Engineer will use the average air void content of the 2 cores to calculate the in-place air voids at the selected location.

c. Air Voids Out of Range. If the in-place air void content in the compacted mixture is below 5% or greater than 9%, change the production and placement operations to bring the in-place air void content within requirements. The Engineer may suspend production until the in-place air void content is brought to the required level, and may require a test section as described in Section 340.4,H.1.d, "Test Section."

d. Test Section. Construct a test section of I lane-width and at most 0.2 mi. in length to demonstrate that compaction to between 5% and 9% in-place air voids can be obtained. Continue this procedure until a test section with 5% to 9% inplace air voids can be produced. The Engineer will allow only 2 test sections per day. When a test section producing satisfactory in-place air void content is placed, resume full production.

2. Ordinary Compaction Control. Furnish the type, size, and number or rollers required for compaction, as approved. Furnish at least 1 medium pneumatic-tire roller (minimum 12-ton weight). Use the control strip method given in Tex-207-F, Part IV, to establish rolling patterns that achieve maximum compaction.

Follow the selected rolling pattern unless changes that affect compaction occur in the mixture or placement conditions. When such changes occur, establish a new rolling pattern. Compact the pavement to meet the requirements of the plans and specifications.

When rolling with the 3-wheel, tandem or vibratory rollers, start by first rolling the joint with the adjacent pavement and then continue by rolling longitudinally at the sides. Proceed toward the center of the pavement, overlapping on successive trips by at least 1 ft., unless otherwise directed. Make alternate trips of the roller slightly different in length. On superelevated curves, begin rolling at the low side and progress toward the high side unless otherwise directed.

I. Irregularities. Immediately take corrective action if surface irregularities, including but not limited to segregation, rutting, raveling, flushing, fat spots, mat slippage, color, texture, roller marks, tears, gouges, streaks, or uncoated aggregate particles, are detected. The Engineer may suspend production or placement operations until the problem is corrected.

At the expense of the Contractor and to the satisfaction of the Engineer, remove and replace any mixture that does not bond to the existing pavement or that has other surface irregularities identified above.

J. Ride Quality. Use Surface Test Type A to evaluate ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.

ITEM 360

CONCRETE PAVEMENT

360.1. Description. Construct hydraulic cement concrete pavement with or without curbs on the concrete pavement.

360.2. Materials.

A. Hydraulic Cement Concrete. Provide hydraulic cement concrete in accordance with Item 421, "Hydraulic Cement Concrete," except that strength over-design is not required. Provide Class P concrete designed to meet a minimum average flexural strength of 570 psi or a minimum average compressive strength of 3,500 psi at 7 days or a minimum average flexural strength of 680 psi or a minimum average compressive strength of 4,400 psi at 28 days. Test in accordance with Tex-448-A or Tex-418-A,

When shown on the plans or allowed, provide Class HES concrete for very early opening of small pavement areas or leave-outs to traffic. Design Class HES to meet the requirements of Class P and a minimum average flexural strength of 400 psi or a minimum average compressive strength of 2,600 psi in 24 hr., unless other early strength and time requirements are shown on the plans or allowed. No strength over design is required. Type III cement is allowed for Class RES concrete.

Use Class A or P concrete for curbs that are placed separately from the pavement. Provide concrete that is workable and cohesive, possesses satisfactory finishing qualities, and conforms to the mix design and mix design slump.

13. Reinforcing Steel. Provide Grade 60 deformed steel for bar reinforcement in accordance with Item 440, "Reinforcing Steel." Provide approved positioning and supporting devices (baskets and chairs) capable of securing and holding the reinforcing steel in proper position before and during paving. Provide corrosion protection when shown on the plans.

1. Dowels. Provide smooth, straight dowels of the size shown on the plans, free of burrs, and conforming to the requirements of Item 440, "Reinforcing Steel," Coat dowels with a thin film of grease or other approved de-bonding material. Provide dowel caps on the lubricated end of each dowel bar used in an expansion joint. Provide dowel caps filled with a soft compressible material with enough range of movement to allow complete closure of the expansion joint.

2. Tie Bars. Provide straight deformed steel tie bars, Provide either multiple-piece tie bars or single-piece tie bars as shown on the plans. Provide multiple-piece tie bars composed of 2 pieces of deformed reinforcing steel with a coupling capable of developing a minimum tensile strength of 125% of the design yield strength of the deformed steel when tensile-tested in the assembled configuration. Provide a minimum length of 33 diameters of the deformed steel in each piece, Use multiple-piece tie bars from the list of "Prequalified Multiple Piece Tie Bar Producers" maintained by the Construction Division, or submit samples for testing in accordance with Tex-711-I,

C. **Curing Materials.** Provide Type 2 membrane curing compound conforming to DMS-4650, "Hydraulic Cement Concrete Curing Materials and Evaporation Retardants," Provide SS-1 emulsified asphalt conforming to Item 300, "Asphalts, Oils, and Emulsions," for concrete pavement to be overlayed with asphalt concrete under this Contract unless otherwise shown on the plans or approved. Provide materials for other methods of curing conforming to the requirements of Item 420, "Concrete Structures."

D. **Epoxy.** Provide Type III epoxy in accordance with DMS-6100, "Epoxies and Adhesives," for installing all drilled-in reinforcing steel.

E. **Evaporation Retardant.** Provide evaporation retardant conforming to DMS-4650, "Hydraulic Cement Concrete Curing Materials and Evaporation Retardants."

F. **Joint Sealants and Fillers.** Provide Class 5 or Class 8 joint-sealant materials and fillers unless otherwise shown on the plans or approved and other sealant materials of the size, shape, and type shown on the plans in accordance with DMS-6310, "Joint Sealants and Fillers."

360.3. Equipment. Furnish and maintain all equipment in good working condition. Use measuring, mixing, and delivery equipment conforming to the requirements of item 421, "Hydraulic Cement Concrete," Obtain approval for other equipment used.

A. Placing, Consolidating, and Finishing Equipment. Provide approved self-propelled paving equipment that uniformly distributes the concrete with minimal segregation and provides a smooth machine-finished consolidated concrete pavement conforming to plan line and grade, Provide an approved automatic grade control system on slip-forming equipment. Provide approved mechanically operated finishing floats capable of producing a uniformly smooth pavement surface. Provide equipment capable of providing a fine, light water fog mist.

Provide mechanically operated vibratory equipment capable of adequately consolidating the concrete. Provide immersion vibrators on the paving equipment at sufficiently close intervals to provide uniform vibration and consolidation of the concrete over the entire width and depth of the pavement and in accordance with the manufacturer's recommendations. Provide immersion vibrator units that operate at a frequency in air of at least 8,000 cycles per minute. Provide enough hand-operated immersion vibrators for timely and proper consolidation of the concrete along forms, at joints and in areas not covered by other vibratory equipment. Surface vibrators may be used to supplement equipment-mounted immersion vibrators. Provide tachometers to verify the proper operation of all vibrators.

For small or irregular areas or when approved, the paving equipment described in this Section is not required.

D. Forming Equipment.

1. **Pavement Forms.** Provide metal side forms of sufficient cross-section, strength, and rigidity to support the paving equipment and resist the impact and vibration of the operation without visible springing or settlement. Use forms that are free from detrimental kinks, bends, or warps that could affect ride quality or alignment. Provide flexible or curved metal or wood forms for curves of 100-ft. radius or less.
2. **Curb Forms.** Provide curb forms for separately placed curbs that are not slipformed that conform to the requirements of Item 529, "Concrete Curb, Gutter, and Combined Curb and Gutter."

C. Reinforcing Steel Inserting Equipment. Provide inserting equipment that accurately inserts and positions reinforcing steel in the plastic concrete parallel to the profile grade and horizontal alignment in accordance to plan details.

D. Texturing Equipment.

1. Carpet Drag. Provide a carpet drag mounted on a work bridge or a moveable support system. Provide a single piece of carpet of sufficient transverse length to span the full width of the pavement being placed and adjustable so that a sufficient longitudinal length of carpet is in contact with the concrete being placed to produce the desired texture. Obtain approval to vary the length and width of the carpet to accommodate specific applications. Use an artificial grass-type carpet having a molded polyethylene pile face with a blade length of 5/8 in, to 1 in., a minimum weight of 70 oz. per square yard, and a strong, durable, rot-resistant backing material bonded to the facing.

2. **Timing Equipment.** Provide a self-propelled transverse metal tine device equipped with 4-in, to 6-in, steel tines and with crosssection approximately 1132 in, thick by 1112 in. wide, spaced at 1 in., center-to-center. Hand-operated timing equipment that produces an equivalent texture may be used only on small or irregularly shaped areas or, when permitted, in emergencies due to equipment breakdown.

E. Curing Equipment. Provide a self-propelled machine for applying membrane curing compound using mechanically pressurized spraying equipment with atomizing nozzles. Provide equipment and controls that maintain the required uniform rate of application over the entire paving area. Provide curing equipment that is independent of all other equipment when production rates are such that the first application of membrane curing compound cannot be accomplished immediately after texturing and after free moisture has disappeared. Hand-operated pressurized spraying equipment with atomizing nozzles may only be used on small or irregular areas or, when permitted, in emergencies due to equipment breakdown.

F. Sawing Equipment. Provide power-driven concrete saws to saw the joints shown on the plans. Provide standby power-driven concrete saws during concrete sawing operations. Provide adequate illumination for nighttime sawing.

G. Grinding Equipment. When required, provide self-propelled powered grinding equipment that is specifically designed to smooth and texture concrete pavement using circular diamond blades. Provide equipment with automatic grade control capable of grinding at least a 3-ft. width longitudinally in each pass without damaging the concrete.

H. Testing Equipment. Provide testing equipment regardless of jobcontrol testing responsibilities in accordance with Item 421, "Hydraulic Cement Concrete," unless otherwise shown in the plans or specified.

1. Coring Equipment. When required, provide coring equipment capable of extracting cores in accordance with the requirements of Tex-424-A.

J. Miscellaneous Equipment. Furnish both 10-ft. and 15-ft. steel or magnesium long-handled standard straightedges, Furnish enough work bridges, long enough to span the pavement, for finishing and inspection operations. Furnish date stencils to impress pavement placement dates into the fresh concrete, with numerals approximately 2 in. high by 1 in. wide by 114 in. deep.

360.4. Construction. Obtain approval for adjustments to plan grade-line to maintain thickness over minor subgrade or base high spots while maintaining clearances and drainage. Maintain subgrade or base in a smooth, clean, compacted condition in conformity with the required section and established grade until the pavement concrete is placed, Keep subgrade or base damp with water sufficiently in advance of placing pavement concrete. Adequately light the active work areas for all nighttime operations. Provide and maintain tools and materials to perform testing.

A Paving and Quality Control Plan. Submit a paving and quality control plan for approval before beginning pavement construction operations, Include details of all operations in the concrete paving process, including longitudinal construction joint layout, sequencing, curing, lighting, early opening, leave-outs, sawing, inspection, testing, construction methods, other details and description of all equipment. List certified personnel performing the testing. Submit revisions to the paving and quality control plan for approval,

B. Job-Control Testing. Unless otherwise shown on the plans, perform all fresh and hardened concrete job-control testing at the specified frequency. Provide job-control testing personnel meeting the requirements of Item 421, "Hydraulic Cement Concrete," Provide and maintain testing equipment, including strength testing equipment at a location acceptable to the Engineer. Use of a commercial laboratory is acceptable. Maintain all testing equipment calibrated in accordance with pertinent test methods. Make strength-testing equipment available to the Engineer for verification testing,

Provide the Engineer the opportunity to witness all tests. The Engineer may require a retest if not given the opportunity to witness. Furnish a copy of all test results to the Engineer daily. Check the first few concrete loads for slump, air, and temperature on start-up production days to check for concrete conformance and consistency, Sample and prepare strength test specimens (2 specimens per test) on the first day of production and for each 3,000 sq. yd. or fraction thereof of concrete pavement thereafter, Prepare at least 1 set of strength-test specimens for each production day. Perform slump, air, and temperature tests each time strength specimens are made. Monitor concrete temperature to ensure that concrete is consistently within the temperature requirements, The Engineer will direct random job-control sampling and testing, Immediately investigate and take corrective action as approved if any Contractor test result, including tests performed for verification purposes, does not meet specification requirements.

When job-control testing by the Contractor is waived by the plans, the Engineer will perform the testing; however, this does not waive the Contractor's responsibility for providing materials and work in accordance with this Item.

1. **Job-Control Strength.** Unless otherwise shown on the plans or permitted by the Engineer, use 7-day job-control concrete strength testing in accordance with Tex-448-A or Tex-418-A,

   For 7-day job-control by flexural strength, use a flexural strength of 520 psi or a lower job-control strength value proven to meet a 28-day flexural strength of 680 psi as correlated in accordance with Tex-427-A. For 7-day job-control by compressive strength, use a compressive strength of 3,200 psi or a lower job-control strength value proven to meet a 28-day compressive strength of 4,400 psi as correlated in accordance with Tex-427-A.

   Job control of concrete strength may be correlated to an age other than 7 days in accordance with Tex-427-A when approved, Job control strength of Class ISS concrete is based on the required strength and time.

   When a job-control concrete strength test value is more than 10% below the required job-control strength or when 3 consecutive jobcontrol strength values fall below the required job-control strength, investigate the strength test procedures, the quality of materials, the concrete production operations, and other possible problem areas to determine the cause. Take necessary action to correct the problem, including redesign of the concrete mix if needed. The Engineer may suspend concrete paving if the Contractor is unable to identify, document, and correct the cause of low strength test values in a timely manner. If any job-control strength is more than 15% below the required job-control strength, the Engineer will evaluate the structural adequacy of the pavements. When directed, remove and replace pavements found to be structurally inadequate at no additional cost.
2. **Split-Sample Verification Testing.** Perform split-sample verification testing with the Engineer on random samples taken and split by the Engineer at a rate of at least 1 for every 10 job control samples, The Engineer will evaluate the results of split sample verification testing. Immediately investigate and take corrective action as approved when results of split-sample verification testing differ more than the allowable differences shown in Table 1, or when the average of 10 job-control strength results and the Engineer's split-sample strength result differ by more than 10%.

Table 1
Verification Testing Limits

Test Method	Allowable Differences
Temperature, Tex-422-A	2°F
Slump, Tex-415-A	1 in.
Air content, Tex-414-A or Tex-416-A	1 %
Flexural strength, Tex-448-A	19%
Compressive strength, Tex-418-A	10%

C. **Reinforcing Steel and Joint Assemblies.** Accurately place and secure in position all reinforcing steel as shown on the plans. Place dowels at mid-depth of the pavement slab, parallel to the surface. Place dowels for transverse contraction joints parallel to the pavement edge. Tolerances for location and alignment of dowels will be shown on the plans. Stagger the longitudinal reinforcement splices to avoid having more than 113 of the splices within a 2-ft. longitudinal length of each lane of the pavement. Use multiple-piece tie bars or drill and epoxy grout tie bars at longitudinal construction joints. Verify that tie bars that are drilled and epoxy into concrete at longitudinal construction joints develop a pullout resistance equal to a minimum of 3/4 of the yield strength of the steel after 7 days. Test 15 bars using ASTM E 488, except that alternate approved equipment may be used. All 15 tested bars must meet the required pullout strength. If any of the test results do not meet the required minimum pullout strength, perform corrective measures to provide equivalent pullout resistance. Repair damage from testing. Acceptable corrective measures include but are not limited to installation of additional or longer tie bars.

1. **Manual Placement,** Secure reinforcing bars at alternate intersections with wire ties or locking support chairs, Tie all splices with wire.
2. **Mechanical Placement.** If mechanical placement of reinforcement results in steel misalignment or improper location, poor concrete consolidation, or other inadequacies, complete the work using manual methods,

D. Joints. Install joints as shown on the plans. Joint sealants are not required on concrete pavement that is to be overlaid with asphaltic materials. Clean and seal joints in accordance with Item 438, "Cleaning and Sealing Joints and Cracks (Rigid Pavement and Bridge Decks)." Repair excessive spalling of the joint saw groove using an approved method before installing the sealant. Seal all joints before opening the pavement to all traffic. When placing of concrete is stopped, install a rigid transverse bulkhead, accurately notched for the reinforcing steel and shaped accurately to the cross-section of the pavement.

1. **Placing Reinforcement at Joints.** Where the plans require an assembly of parts at pavement joints, complete and place the assembly at the required location and elevation with all parts rigidly secured in the required position. Accurately notch joint materials for the reinforcing steel.
2. **Transverse Construction Joints,**

a. **Continuously Reinforced Concrete Pavement (CRCP).** Install additional longitudinal reinforcement through the bulkhead when shown on the plans. Protect the reinforcing steel immediately beyond the construction joint from damage, vibration, and impact.

b. Concrete Pavement Contraction Design (CPCD). When the placing of concrete is intentionally stopped, install and rigidly secure a complete joint assembly and bulkhead in the planned transverse contraction joint location. When the placing of concrete is unintentionally stopped, install a transverse construction joint either at a planned transverse contraction joint location or mid-slab between planned transverse contraction joints. For mid-slab construction joints, install tie bars of the size and spacing used in the longitudinal joints.

c. Curb Joints. Provide joints in the curb of the same type and location as the adjacent pavement. Use expansion joint material of the same thickness, type, and quality required for the pavement and of the section shown for the curb. Extend expansion joints through the curb. Construct curb joints at all transverse pavement joints. For non-monolithic curbs, place reinforcing steel into the plastic concrete pavement as shown on the plans unless otherwise approved. Form or saw the weakened plane joint across the full width of concrete pavement and through the monolithic curbs. Construct curb joints in accordance with Item 529, "Concrete Curb, Gutter, and Combined Curb and Gutter."

E. **Placing and Removing Forms.** Use clean and oiled forms. Secure forms on a base or firm subgrade that is accurately graded and that provides stable support without deflection and movement by form riding equipment. Pin every form at least at the middle and near each end. Tightly join and key form sections together to prevent relative displacement.

Set side forms far enough in advance of concrete placement to permit inspection. Check conformity of the grade, alignment, and stability of forms immediately before placing concrete, and make all necessary corrections. Use a straightedge or other approved method to test the top of forms to ensure that the ride quality requirements for the completed pavement will be met. Stop paving operations if forms settle or deflect more than 1/8 in. under finishing operations. Reset forms to line and grade, and refinish the concrete surface to correct grade.

Avoid damage to the edge of the pavement when removing forms. Repair damage resulting from form removal and honeycombed areas with a mortar mix within 24 hr. after form removal unless otherwise approved. Clean joint face and repair honeycombed or damaged areas within 24 hr. after a bulkhead for a transverse construction joint has been removed unless otherwise approved. When forms are removed before 72 hr. after concrete placement, promptly apply membrane curing compound to the edge of the concrete pavement. Forms that are not the same depth as the pavement but are within 2 in. of that depth are permitted if the subbase is trenched or the full width and length of the form base is supported with a firm material to produce the required pavement thickness. Promptly repair the form trench after use. Use flexible or curved wood or metal forms for curves of 100-ft. radius or less,

F. **Concrete Delivery.** Clean delivery equipment as necessary to prevent accumulation of old concrete before loading fresh concrete. Use agitated delivery equipment for concrete designed to have a slump of more than 5 in. Segregated concrete is subject to rejection. Place agitated concrete within 60 min. after batching, Place non-agitated concrete within 45 min. after batching. In hot weather or under conditions causing quick setting of the concrete, times may be reduced by the Engineer. Time limitations may be extended if the Contractor can demonstrate that the concrete can be properly placed, consolidated, and finished without the use of additional water.

G. **Concrete Placement.** Do not allow the pavement edge to deviate from the established paving line by more than 1/2 in, at any point. Place the concrete as near as possible to its final location, and minimize segregation and rehandling. Where hand spreading is necessary, distribute concrete using shovels. Do not use rakes or vibrators to distribute concrete.

1. **Pavement.** Consolidate all concrete by approved mechanical vibrators operated on the front of the paving equipment, Use immersion-type vibrators that simultaneously consolidate the full width of the placement when machine finishing, Keep vibrators from dislodging reinforcement. Use hand-operated vibrators to consolidate concrete in areas not accessible to the machinemounted vibrators, Do not operate machine-mounted vibrators while the paving equipment is stationary. Vibrator operations are subject to review.
2. **Date Imprinting.** Imprint dates in the fresh concrete indicating the date of the concrete placement. Make impressions approximately 1 ft. from the outside longitudinal construction joint or edge of pavement and approximately 1 ft. from the transverse construction joint at the beginning of the placement day. Orient the impressions to be read from the outside shoulder in the direction of final traffic, Impress date in DD-MM-YY format. Imprinting of the Contractor name or logo in similar size characters to the date is allowed.
3. **Curbs.** Where curbs are placed separately, conform to the requirements of Item 529, "Concrete Curb, Gutter, and Combined Curb and Gutter."
4. **Temperature Restrictions.** Place concrete that is between 40°F and 95°F when measured in accordance with Tex-422-A at the time of discharge, except that concrete may be used if it was already in transit when the temperature was found to exceed the allowable maximum. Take immediate corrective action or cease concrete production when the concrete temperature exceeds 95°F,

   Do not place concrete when the ambient temperature in the shade is below 40°F and falling unless approved. Concrete may be placed when the ambient temperature in the shade is above 35°F and rising or above 40°F. When temperatures warrant protection against freezing, protect the pavement with an approved insulating material capable of protecting the concrete for the specified curing period. Submit for approval proposed measures to protect the concrete from anticipated freezing weather for the first 72 hr. after placement. Repair or replace all concrete damaged by freezing.

H. Spreading and Finishing. Finish all concrete pavement with approved self-propelled equipment, Use power-driven spreaders, power-driven vibrators, power-driven strike-off, and screed, or approved alternate equipment. Use the transverse finishing equipment to compact and strike off the concrete to the required section and grade without surface voids, Use float equipment for final finishing. Use concrete with a consistency that allows completion of all finishing operations without addition of water to the surface. Use the minimal amount of water fog mist necessary to maintain a moist surface. Reduce fogging if float or straightedge operations result in excess slurry.

1. Finished **Surface.** Perform sufficient checks with long-handled 10-ft. and 15-ft. straightedges on the plastic concrete to ensure that the final surface is within the tolerances specified in Surface Test A in Item 585, "Ride Quality for Pavement Surfaces," Check with the straightedge parallel to the centerline,
2. **Maintenance of *Surface* Moisture.** Prevent surface drying of the pavement before application of the curing system. Accomplish this by fog applications of evaporation retardant on the pavement surface, Apply evaporation retardant at the rate recommended by the manufacturer, Reapply the evaporation retardant as needed to maintain the concrete surface in a moist condition until curing system is applied, Do not use evaporation retardant as a finishing aid. Failure to take acceptable precautions to prevent surface drying of the pavement will be cause for shut down of pavement operations.
3. **Surface Texturing.** Perform surface texturing using a combination of a carpet drag and metal timing, Complete final texturing before the concrete has attained its initial set, Draw the carpet drag longitudinally along the pavement surface with the carpet contact surface area adjusted to provide a satisfactory coarsely textured surface.

A metal-tine texture finish is required unless otherwise shown on the plans. Provide the metal-tine finish immediately after the concrete surface has set enough for consistent timing. Operate the metal-tine device to obtain grooves spaced at 1 in,, approximately 3116 in, deep, with a minimum depth of 118 in., and approximately 1112 in. wide. Do not overlap a previously tined area. Use manual methods for achieving similar results on ramps and other irregular sections of pavements. Repair damage to the edge of the slab and joints immediately after texturing. Do not tine pavement that will be overlaid.

4. **Small or Irregular Placements.** Where machine placements and finishing of concrete pavement are not practical, use hand equipment and procedures that produce a consolidated and finished pavement section to the line and grade.
5. **Emergency Procedures.** Use hand-operated equipment for applying texture, evaporation retardant, and cure in the event of equipment breakdown.
6. **Curing.** Keep the concrete pavement surface from drying by water fogging until the curing material has been applied. Maintain and promptly repair damage to curing materials on exposed surfaces of concrete pavement continuously for at least 3 curing days. A curing day is defined as a 24-hr. period when either the temperature taken in the shade away from artificial heat is above 50°F for at least 19 hr. or when the surface temperature of the concrete is maintained above 40°F for 24 hr. Curing begins when the concrete curing system has been applied. Stop concrete paving if curing compound is not being applied promptly and maintained adequately. Other methods of curing in accordance with Item 420, "Concrete Structures," may be used when specified or approved.

1. **Membrane Curing.** After texturing and immediately after the free surface moisture has disappeared, spray the concrete surface uniformly with 2 coats of membrane curing compound at an individual application rate of not more than 180 sq. ft. per gallon. Apply the first coat within 10 min, after completing texturing operations, Apply the second coat within 30 min. after completing texturing operations.

Before and during application, maintain curing compounds in a uniformly agitated condition, free of settlement. Do not thin or dilute the curing compound.

Where the coating shows discontinuities or other defects or if rain falls on the newly coated surface before the film has dried enough to resist damage, apply additional compound at the same rate of coverage to correct the damage. Ensure that the curing compound coats the sides of the timing grooves.

2. **Asphalt Curing.** When an asphaltic concrete overlay is required, apply a uniform coating of asphalt curing at a rate of 90 to 180 sq. ft. per gallon as required. Apply curing immediately after texturing and just after the free moisture (sheen) has disappeared, Obtain approval to add water to the emulsion to improve spray distribution. Maintain the asphalt application rate when using diluted emulsions, Maintain the emulsion in a mixed condition during application.

3. Curing Class HES Concrete. For all Class FES concrete pavement, provide membrane curing in accordance with Section 360.4.1.1, "Membrane Curing," followed promptly by water curing until opening strength is achieved but not less than 24 hr.

J. **Sawing Joints.** Saw joints to the depth shown on the plans as soon as sawing can be accomplished without damage to the pavement regardless of time of day or weather conditions. Some minor raveling of the saw cut is acceptable. Use a chalk line, string line, sawing template, or other approved method to provide a true joint alignment. Provide enough saws to match the paving production rate to ensure sawing completion at the earliest possible time to avoid uncontrolled cracking. Reduce paving production if necessary to ensure timely sawing of joints. Promptly restore membrane cure damaged within the first 72 hr. of curing.

K. **Protection of Pavement and Opening to Traffic.** Testing for early opening is the responsibility of the Contractor regardless of job-control testing responsibilities unless otherwise shown in the plans or directed. Testing result interpretation for opening to traffic is subject to the approval of the Engineer.

1. Protection of Pavement, Erect and maintain barricades and other standard and approved devices that will exclude all vehicles and equipment from the newly placed pavement for the periods specified. Before opening to traffic, protect the pavement from damage due to crossings using approved methods. Where a detour is not readily available or economically feasible, an occasional crossing of the roadway with overweight equipment may be permitted for relocating equipment only but not for hauling material. When an occasional crossing of overweight equipment is permitted, temporary matting or other approved methods may be required.
Maintain an adequate supply of sheeting or other material to cover and protect fresh concrete surface from weather damage. Apply as needed to protect the pavement surface from weather.

2. **Opening Pavement to** All Traffic. Pavement that is 7 days old may be opened to all traffic. Before opening to traffic, clean pavement, place stable material against the pavement edges, seal joints, and perform all other traffic safety related work,

3. **Opening Pavement to Construction Equipment.** Unless otherwise shown on the plans, concrete pavement may be opened early to concrete paving equipment and related delivery equipment after the concrete is at least 48 hr. old and opening strength has been demonstrated in accordance with Section 360.4.K,4, "Early Opening to All Traffic," before curing is complete. Keep delivery equipment at least 2 ft. from the edge of the concrete pavement. Keep tracks of the paving equipment at least 1 ft. from the pavement edge. Protect textured surfaces from the paving equipment. Restore damaged membrane curing as soon as possible. Repair pavement damaged by paving or delivery equipment before opening to all traffic.

4. **Early Opening to** All **Traffic.** Concrete pavement may be opened after curing is complete and the concrete has attained a flexural strength of 450 psi or a compressive strength of 2,800 psi, except that pavement using Class IIES concrete may be opened after 24 hr. if the specified strength is achieved.

a. **Strength Testing.** Test concrete specimens cured under the same conditions as the portion of the pavement involved.

b. **Maturity Method.** Unless otherwise shown on the plans, the maturity method, Tex-426-A, may be used to estimate concrete strength for early opening pavement to traffic. Install at least 2 maturity thermocouples for each day's placement in areas where the maturity method will be used for early opening. Thermocouples, when used, will be installed near the days final placement for areas being evaluated for early opening. Use test specimens to verify the strength-maturity relationship in accordance with Tex-426-A, starting with the first day's placement corresponding to the early opening pavement section.

c. After the first day, verify the strength-maturity relationship at least every 10 days of production. Establish a new strength maturity relationship when the strength specimens deviate more than 10% from the maturity-estimated strengths. Suspend use of the maturity method for opening pavements to traffic when the strength-maturity relationship deviates by more than 10% until a new strength-maturity relationship is established.

When the maturity method is used intermittently or for only specific areas, the frequency of verification will be as determined by the Engineer.

5. Emergency Opening to Traffic. Under emergency conditions, when the pavement is at least 72 hr. old, open the pavement to traffic when directed in writing. Remove all obstructing materials, place stable material against the pavement edges, and perform other work involved in providing for the safety of traffic as required for emergency opening.

L. Pavement Thickness. The Engineer will check the thickness in accordance with Tex-423-A unless other methods are shown on the plans. The Engineer will perform 1 thickness test consisting of 1 reading at approximately the center of each lane every 500 ft. or fraction thereof, Core where directed in accordance with Tex-424-A to verify deficiencies of more than 0.2 in. from plan thickness and to determine the limits of deficiencies of more than 0.75 in, from plan thickness. Fill core holes using a concrete mixture and method approved by the Engineer.

1. **Thickness Deficiencies Greater than 0.2 in.** When any depth test measured in accordance with Tex-423-A is deficient by more than 0.2 in, from the plan thickness, take one 4-in. diameter core at that location to verify the measurement.

   If the core is deficient by more than 0.2 in, but not by more than 0,75 in. from the plan thickness, take 2 additional cores from the unit (as defined in Section 360.4.L,3, "Pavement Units for Payment Adjustment") at intervals of at least 150 ft. and at locations selected by the Engineer, and determine the thickness of the unit for payment purposes by averaging the length of the 3 cores. In calculations of the average thickness of this unit of pavement, measurements in excess of the specified thickness by more than 0.2 in. will be considered as the specified thickness plus 0,2 in.

2. **Thickness Deficiencies** Greater than **0.75 in.** If a core is deficient by more than 0.75 in., take additional cores at 10 ft, intervals in each direction parallel to the centerline to determine the boundary of the deficient area. The Engineer will evaluate any area of pavement found deficient in thickness by more than 0.75 in. but not more than 1 in. As directed, remove and replace the deficient areas without additional compensation or retain deficient areas without compensation. Remove and replace any area of pavement found deficient in thickness by more than 1 in. without additional compensation.

3.

3. Pavement Units for Payment Adjustment. Limits for applying a payment adjustment for deficient pavement thickness from 0.20 in. to not more than 0.75 in. are 500 ft. of pavement in each lane. Lane width will be as shown on typical sections and pavement design
standards.

For greater than 0.75 in. deficient thickness, the limits for applying zero payment or requiring removal will be defined by coring or equivalent nondestructive means as determined by the Engineer. The remaining portion of the unit determined to be less than 0,75 in. deficient will be subject to the payment adjustment based on the average core thickness at each end of the 10 ft. interval investigation as determined by the Engineer.

Shoulders will be measured for thickness unless otherwise shown on the plans. Shoulders 6 ft, wide or wider will be considered as lanes. Shoulders less than 6 ft. wide will be considered part of the adjacent lane. Limits for applying payment adjustment for deficient pavement thickness for ramps, widenings, acceleration and deceleration lanes, and other miscellaneous areas are 500 ft. in length. Areas less than 500 ft, in length will be individually evaluated for payment adjustment based on the plan area,

M. Ride Quality. Unless otherwise shown on the plans, measure ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces."

ITEM 400

EXCAVATION AND BACKFILL FOR STRUCTURES

400.1. Description. Excavate for placement and construction of structures and backfill structures, Cut and restore pavement.

400.2. Materials. Use materials that meet the requirements of the following Items:

- Item 401, "Plowable Backfill"
- Item 421, "Hydraulic Cement Concrete"
- DMS-4600, "Hydraulic Cement"

400.3. Construction.

A. Excavation.

1. General. Excavate to the lines and grades shown on the plans or as directed, Provide slopes, benching, sheeting, bracing, pumping, and bailing as necessary to maintain the stability and safety of excavations up to 5 ft. deep. Excavation protection for excavations deeper than 5 ft. are governed by Item 402, "Trench Excavation Protection," and Item 403, "Temporary Special Shoring." Use satisfactory excavated material as backfill or as embankment fill in accordance with Item 132, "Embankment." Dispose of material not incorporated into the final project off the right of way in accordance with federal, state, and local regulations.

When excavating for installation of structures across private property or beyond the limits of the embankment, keep any topsoil removed separate, and replace it, as nearly as feasible, in its original position, Restore the area to an acceptable condition.
Excavate drilled shafts in accordance with Item 416, "Drilled Shaft Foundations."

a. Obstructions. Remove obstructions to the proposed construction, including trees and other vegetation, debris, and structures, over the width of the excavation to a depth of 1 ft, below the bottom of excavation, If abandoned storm drains, sewers, or other drainage systems are encountered, remove as required to clear the new structure, and plug in an approved manner. After removing obstructions, restore the bottom of the excavation to grade by backfilling in accordance with this Item. Dispose of surplus materials in accordance with federal, state, and local regulations.

b. Excavation in *Streets.* When structures are installed in streets, highways, or other paved areas, cut pavement and base to neat lines. Restore pavement structure after completion of excavation and backfilling.

Maintain and control traffic in accordance with the approved traffic control plan and the TMUTCD.

c. Utilities. Comply with the requirements of Article 7,12, "Responsibility for Damage Claims."

d. Conduct work with minimum disturbance of existing utilities, and coordinate work in or near utilities with the utility owners. Inform utility owners sufficiently before work begins to allow them time to identify, locate, reroute, or make other adjustments to utility lines.

Avoid cutting or damaging underground utility lines that are to remain in place. If damage occurs, promptly notify the utility company, If an active sanitary sewer line is damaged during excavation, provide temporary flumes across the excavation while open, and restore the lines when backfilling has progressed to the original bedding lines of the cut sewer.

e. De-Watering. Do not construct or place structures in the presence of water unless approved. Place

precast members, pipe, and concrete only on a dry, firm surface. Remove water by bailing, pumping, well-point installation, deep wells, underdrains, or other approved method.

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If structures are approved for placement in the presence of water, remove standing water in a manner that does not allow water movement through or alongside concrete being placed. Do not pump or bail while placing structural concrete or for a period of at least 36 hr. thereafter unless from a suitable sump separated from the concrete work. Pump or bail during placement of seal concrete only to the extent necessary to maintain a static head of water within the cofferdam, Do not pump or bail to de-water inside a sealed cofferdam until the seal has aged at least 36 hr.
If the bottom of an excavation cannot be de-watered to the point that the subgrade is free of mud or it is difficult to keep reinforcing steel clean, place a stabilizing material in the bottom of the excavation. Stabilizing material may be flexible base, cement-stabilized base or backfill, lean concrete, or other approved material. If lean concrete is used, provide concrete with at least 275 lb. of cement per cubic yard, and place to a minimum depth of 3 in. Stabilizing material placed for the convenience of the Contractor will be at the Contractor's expense.

2. **Bridge Foundations and Retaining Walls.** Do not disturb material below the bottom of footing grade. Do not backfill to compensate for excavation that has extended below grade. If excavation occurs below the proposed footing grade, fill the area with concrete at the time the footing is placed. The additional concrete placed will be at the Contractor's expense.

   If requested, take cores to determine the character of the supporting materials. Provide an intact sample adequate to judge the character of the founding material. Take these cores when the excavation is close to completion, Cores should be approximately 5 ft. deeper than the proposed founding grade,
   If the founding stratum is rock or other hard material, remove loose material, clean, and cut to a firm surface that is level, stepped, or serrated, as directed. Clean out soft seams, and fill with concrete at the time the-footing is placed.

   If the material at the footing grade of a retaining wall, bridge bent, or pier is a mixture of compressible and incompressible material, do not place the foundation until the Engineer has inspected the excavation and authorized changes have been made to provide a uniform bearing condition.

3. **Cofferdams.** The term "cofferdam" designates any temporary or removable structure constructed to hold surrounding earth, water, or both out of the excavation whether the structure is formed of soil, timber, steel, concrete, or a combination of these. Cofferdams may require the use of pumping wells or well points for de-watering.

   For sheet-pile or other types of cofferdams requiring structural members, submit details and design calculations bearing the seal of a licensed professional engineer for review before constructing the cofferdam, The Department reserves the right to reject designs. Design structural systems to comply with the AASHTO *Standard Specifications for Highway Bridges* or AASHTO *LRFD Bridge Design Specifications.* Interior dimensions of cofferdams must provide sufficient clearance for the construction, inspection, and removal of required forms and, if necessary, sufficient room to allow pumping outside the forms. In general, extend sheet-pile cofferdams well below the bottom of the footings, and make concrete seals as well braced and watertight as practicable.

For foundation seals, use Class E concrete unless otherwise specified. Place concrete foundation seals in accordance with Item 420, "Concrete Structures." Seals placed for the convenience of the Contractor will be at the Contractor's expense.
When the Engineer judges it to be impractical to de-water inside a cofferdam and a concrete seal is to be placed around piling driven within the cofferdam, make the excavation deep enough to allow for swelling of the material at the base of the excavation during pile-driving operations. Amer driving the piling, remove swelling material to the bottom of the seal grade. Where it is possible to de water inside the cofferdam without placing a seal, remove the foundation material to exact footing grades after driving piling. Do not backfill a foundation to compensate for excavation that has been extended below grade; fill such areas below grade with concrete at the time the seals or footings are placed.

Unless otherwise provided, remove cofferdams after completing the substructure without disturbing or damaging the structure.

4. Culverts and Storm Drains. When the design requires special bedding conditions for culverts or storm drains, an excavation diagram will be shown on the plans. Do not exceed these limits of excavation.
Unless otherwise shown on the plans, construct pipe structures in an open cut with vertical sides extending to a point 1 ft. above the pipe. When site conditions or the plans do not prohibit sloping the cut, the excavation may be stepped or laid back to a stable slope beginning 1 ft. above the pipe. Maintain the stability of the excavation throughout the construction period.

For pipe to be installed in fill above natural ground, construct the embankment to an elevation at least 1 ft. above the top of the pipe, and then excavate for the pipe.

a. Unstable Material. When unstable soil is encountered at established footing grade, remove the material to a depth of no more than 2 ft. below the grade of the structure unless the Engineer authorizes additional depth. Replace soil removed with stable material in uniform layers at most 8 in. deep (loose measurement). Each layer must have enough moisture to be compacted by rolling or tamping as required to provide a stable foundation for the structure.

When it is not feasible to construct a stable foundation as outlined above, use special materials such as flexible base, cement-stabilized base, cement-stabilized backfill, or other approved material.

b. Incompressible Material. If rock, part rock, or other incompressible material is encountered at established footing grade while placing prefabricated elements, remove the incompressible material to 6 in. below the footing grade, backfill with an approved compressible material, and compact in accordance with Section 400.3.C, "Backfill."

B. Shaping and Bedding. For precast box sections, place at least 2 in, of fine granular material on the base of the excavation before placing the box sections. For pipe installations, use bedding as shown in Figure 1, Use Class C bedding unless otherwise shown on the plans. The Engineer may require the use of a template to secure reasonably accurate shaping of the foundation material. Where cement-stabilized backfill is indicated on the plans, undercut the excavation at least 4 in. and backfill with stabilized material to support the pipe or box at the required grade.

C. Backfill.

1. General. As soon as practical, backfill the excavation after placement of the permanent structure. Use backfill free from stones large enough to interfere with compaction; large or frozen lumps that will not break down readily under compaction; and wood or other extraneous material. Obtain backfill material from excavation or from other sources.

In areas not supporting a completed roadbed, retaining wall, or embankment, place backfill in layers at most 10 in. deep (loose measurement). In areas supporting a portion of a roadbed, retaining wall, or embankment, place backfill in uniform layers at most 8 in. deep (loose measurement). Compact each layer to meet the density requirements of the roadbed, retaining wall, embankment material, or as shown on the plans.

Bring each layer of backfill material to the moisture content needed to obtain the required density. Use mechanical tamps or rammers to compact the backfill. Rollers may be used to compact backfill if feasible.

Cohesionless materials such as sand may be used for backfilling. Compact cohesionless materials using vibratory equipment, waterponding, or a combination of both.

2. Bridge Foundations, Retaining Walls, and Box Culverts. Do not place backfill against the structure until the concrete has reached the design strength required in Item 421, "Hydraulic Cement Concrete."

Backfill retaining walls with material meeting the requirements of Item 423, "Retaining Walls." Backfill around bridge foundations and culverts using material with no particles more than 4 in, in greatest dimension and with a gradation that permits thorough compaction. Rock or gravel mixed with soil may be used if the percentage of fines is sufficient to fill all voids and ensure a uniform and thoroughly compacted mass of proper density.

Where backfill material is being placed too close to the structure to permit compaction with blading and rolling equipment, use mechanical tamps and rammers to avoid damage to the structure.

Avoid wedging action of backfill against structures. To prevent such action, step or serrate slopes bounding the excavation. Place backfill uniformly around bridge foundations. Place backfill along both sides of culverts equally and in uniform layers.

The Engineer may require backfilling of structures excavated into hard, erosion-resistant material, and subject to erosive forces, with stone or lean concrete.

Box culverts may be opened to traffic as soon as sufficient backfill and embankment has been placed over the top to protect culverts against damage from heavy construction equipment. Repair damage to culvert caused by construction traffic at no additional expense to the Department.

3. **Pipe.** After installing bedding and pipe as required, bring backfill material to the proper moisture condition and place it equally along both sides of the pipe in uniform layers at most 8 in, deep (loose measurement), Compact each lift mechanically. Thoroughly compact materials placed under the haunches of the pipe to prevent damage or displacement of the pipe. Continue to place backfill in this manner to the top-of-pipe elevation. Place and compact backfill above the top of the pipe in accordance with Section 400.3.C.1, "General."

The Engineer may reject backfill material containing more than 20% by weight of material retained on a 3-in. sieve; with large lumps not easily broken down; or that cannot be spread in loose layers. Material excavated by a trenching machine will generally meet the requirements of this Section as long as large stones are not present.

Where pipe extends beyond the toe of slope of the embankment and the depth of cover provided by backfill to the original ground level is less than the minimum required by the specifications for the type of pipe involved, place and compact additional material until the minimum cover has been provided.

4, Cement-Stabilized Backfill. When shown on the plans, backfill the excavation to the elevations shown with cement-stabilized backfill. Use cement-stabilized backfill that contains aggregate, water, and a minimum of 7% hydraulic cement based on the dry weight of the aggregate, in accordance with Tex-120-E. Use clean sand as aggregate for cement-stabilized backfill unless otherwise shown on the plans. Use only approved aggregate.

Place cement-stabilized backfill equally along the sides of structures to prevent strain on or displacement of the structure, Fill voids when placing cement-stabilized backfill. Use hand operated tampers if necessary to fill voids.

5. Plowable Backfill. When shown on the plans, backfill the excavation with flowable backfill to

the elevations shown. Prevent the structure from being displaced during the placement of the flowable fill, and prevent flowable fill from entering culverts and drainage structures.

ITEM 402

TRENCH EXCAVATION PROTECTION

402.1. Description. Furnish and place excavation protection for trenches deeper than 5 ft.

402.2. Construction. Provide vertical or sloped cuts, benches, shields, support systems, or other systems providing the necessary protection in accordance with OSHA Standards and Interpretations, 29 CFR 1926, Subpart P, "Excavations."

ITEM 420
CONCRETE STRUCTURES

420.1. Description. Construct concrete structures.

420.2. Materials.

A. Concrete. Provide concrete conforming to Item 421, "Hydraulic Cement Concrete," For each type of structure or unit, provide the class of concrete shown on the plans or in pertinent governing specifications.

B. Grout or Mortar. Provide grout or mortar conforming to Section 421.2.F', "Mortar and Grout."

C. Latex. Provide an acrylic-polymer latex admixture (acrylic resin emulsion per DMS-4640, "Chemical Admixtures for Concrete") suitable for producing polymer-modified concrete or mortar. Do not allow latex to freeze.

D. Reinforcing Steel. Provide reinforcing steel conforming to Item 440, "Reinforcing Steel."

E. Expansion Joint Material. Provide materials that conform to the requirements of DMS-6310, "Joint Sealants and Fillers":

- Provide preformed fiber expansion joint material that conforms to the dimensions shown on the plans.
- Provide preformed bituminous fiber material unless otherwise specified.
- Provide a Class 4, 5, or 7 low-modulus silicone sealant unless otherwise directed,
- Provide asphalt board that conforms to dimensions shown on the plans.
- Provide re-bonded neoprene filler that conforms to the dimensions shown on the plans

F. Waterstop. Provide rubber or polyvinyl chloride (PVC) waterstops that conform to DMS-6160, Waterstops, Nylon Reinforced Neoprene Sheet, and Elastomeric Pads," unless otherwise shown on the plans.

G. Evaporation Retardants. Provide evaporation retardants that conform to the requirements of DMS-4650, "Hydraulic Cement Concrete Curing Materials and Evaporation Retardants."

H. Curing Materials. Provide membrane curing compounds that conform to the requirements of DMS-4650, "Hydraulic Cement Concrete Curing Materials and Evaporation Retardants."

Provide cotton mats that consist of a filling material of cotton "bat" or "bats" (at least 12 oz. per square yard) completely covered with unsized cloth (at least 6 oz. per square yard) stitched longitudinally with continuous parallel rows of stitching spaced at less than 4 in., or tuft both longitudinally and transversely at intervals less than 3 in. Provide cotton mats that are free from tears and in good general condition. Provide a flap at least 6 in. wide consisting of 2 thicknesses of the covering and extending along 1 side of the mat.
Provide polyethylene sheeting that is at least 4 mils thick and free from visible defects. Provide only clear or opaque white sheeting when the ambient temperature during curing exceeds 60°F or when applicable to control temperature during mass pours.

Provide burlap-polyethylene mats made from burlap impregnated on 1 side with a film of opaque white pigmented polyethylene, free from visible defects. Provide laminated mats that have at least 1 layer of an impervious material such as polyethylene, vinyl plastic, or other acceptable material (either as a solid sheet or impregnated into another fabric) and are free of visible defects.

I. **Epoxy.** Unless otherwise specified, provide epoxy materials that conform to DMS-6100, "Epoxy and Adhesives."

420.3. Equipment.

A. Fogging Equipment. Use fogging equipment that can apply water in a fine mist, not a spray. Produce the fog using equipment that pumps water or water and air under high pressure through a suitable atomizing nozzle. Use hand-held mechanical equipment portable enough to use in the direction of any prevailing wind and adaptable for intermittent use to prevent excessive wetting of the concrete.

B. Transporting and Placing Equipment. Use appropriate transporting and placing equipment such as buckets, chutes, buggies, belt conveyors, pumps, or other equipment as necessary, Do not transport or convey concrete through equipment made of aluminum, Use carts with pneumatic tires for carting or wheeling concrete over newly placed slabs.

Use tremies to control the fall of concrete or for underwater placement, Use tremies that are watertight and of large enough diameter to allow the placement of the concrete but less than 14 in. in diameter. For underwater placements, construct the tremie so that the bottom can be sealed and opened once the tremie has been fully charged with concrete.

Use pumps with lines at least 5 in. I,D, where Grade 2 or smaller coarse aggregate is used, and at least 8 in. I.D. for Grade 1 coarse aggregate.

C. Vibrators. Use immersion-type vibrators for consolidation of concrete. Provide at least I standby vibrator for emergency use.

D. Screeds and Work Bridges for Bridge Slabs. For bridge slabs use a self-propelled transverse screed or a mechanical longitudinal screed. Use transverse screeds that are able to follow the skew of the bridge for skews greater than 15° unless otherwise approved, Equip transverse screeds with a pan float. Manually operated screeding equipment may be used if approved for top slabs of culverts, small placements, or unusual conditions. Use screeds that are rigid and heavy enough to hold true to shape and have sufficient adjustments to provide for the required camber or section. Equip the screeds, except those of the roller drum type, with metal cutting edges.

For bridge slabs, use sufficient work bridges for finishing operations, Mount a carpet drag to a work bridge or a moveable support system that can vary the area of carpet in contact with the concrete, Use carpet pieces long enough to cover the entire width of the placement. Splice or overlap the carpet as necessary. Ensure that enough carpet is in contact longitudinally with the concrete being placed to provide the desired surface finish, Use artificial grass-type carpeting having a molded polyethylene pile face with a blade length between 5/8 and 1 in, and with a minimum weight of 70 oz. per square yard. Ensure that the carpet has a strong, durable backing not subject to rot and that the facing is adequately bonded to the backing to withstand the intended use. A burlap drag, attached to the pan float on a transverse screed, may be used instead of the carpet drag.

E. Temperature Recording Equipment. For mass concrete operations or as otherwise specified, use strip chart temperature recording devices, recording maturity meters in accordance with Tex-426-A, or other approved devices that are accurate to within ±2°F within the range of 32 to 2I2°F.

F. Artificial Heating Equipment. Use artificial heating equipment as necessary for maintaining the concrete temperatures as specified in Section 420.4,0,1 I, "Placing Concrete in Cold Weather."

G. Sawing Equipment. Use sawing equipment capable of cutting grooves in completed bridge slabs and top slabs of direct-traffic culverts. Provide grooves that are 118 to 3116 in, deep and nominally 1/8 in.

wide. Groove spacing may range from 5/8 to 1 in. Use sawing equipment capable of cutting grooves in hardened concrete to within 18 in, of the barrier rail or curb.

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H. **Spraying Equipment.** Use mechanically powered pressure sprayers, either air or airless, with appropriate atomizing nozzles for the application of membrane curing, Mechanically driven spraying equipment, adaptable to the rail system used by the screeds, may be used for applying membrane curing to bridge slabs. If approved, use hand-pressurized spray equipment equipped with 2 or 3 fan-spray nozzles. Ensure that the spray from each nozzle overlaps the spray from adjacent nozzles by approximately 50%.

I. Concrete Testing Equipment. Provide testing equipment for use by the Engineer in accordance with Section 421.3.C, "Testing Equipment."

420.4. Construction. Before starting work, obtain approval for proposed construction methods. Approval of construction methods and equipment does not relieve the Contractor's responsibility for safety or correctness of methods, adequacy of equipment, or completion of work in full accordance with the Contract.

Unless otherwise shown on the plans, it is the Contractor's option to perform testing on structural concrete (structural classes of concrete are identified in Table 5 of Section 421.4.A, "Classification and Mix Design") to determine the in-situ strength to address the schedule restrictions in Section 420.4.A, "Schedule Restrictions," The Engineer may require the Contractor to perform this testing for concrete placed in cold weather. For Contractor-performed testing, make enough test specimens to ensure that strength requirements are met for the operations listed in Section 420,4,A. Make at least 1 set of test specimens for each element cast each day. Cure these specimens under the same conditions as the portion of the structure involved for all stages of construction. Ensure safe handling, curing, and storage of all test specimens. Provide testing personnel, and sample and test the hardened concrete in accordance with Section 421.4.G, "Sampling and Testing of Concrete." The maturity method, Tex-426-A, may be used for in-situ strength determination for schedule restrictions if approved. Coring will not be allowed for in-situ strength determination for schedule restrictions. Provide the Engineer the opportunity to witness all testing operations. Report all test results to the Engineer.

If the Contractor does not wish to perform schedule restriction testing, the Engineer's 7-day lab-cured tests, performed in accordance with Section 421.4.0.5, "Adequacy and Acceptance of Concrete," will be used for schedule restriction determinations, The Engineer may require additional time for strength gain to account for field curing conditions such as cold weather.

A. **Schedule Restrictions.** Unless otherwise shown on the plans, construct and open completed structures to traffic with the following limitations:

1. Setting Forms. Attain at least 2,500 psi compressive strength before erecting forms on concrete footings supported by piling or drilled shafts, or on individual drilled shafts. Erect forms on spread footings and culvert footings after the footing concrete has aged at least 2 curing days as defined in Section 420,4.J, "Curing Concrete." Place concrete only after the forms and reinforcing steel have been inspected by the Engineer. Support tie beam or cap forms by falsework on previously placed tie beams only if the tie beam concrete has attained a compressive strength of 2,500 psi and the member is properly supported to eliminate stresses not provided for in the design. Maintain curing as required until completion of the curing period,
Place superstructure forms or falsework on the substructure only if the substructure concrete has attained a compressive strength of 3,000 psi.

2. **Removal of Forms and Falsework.** Keep in place weight supporting forms and falsework for bridge components and culvert slabs until the concrete has attained a compressive strength of 2,500 psi in accordance with Section 420.4.K, "Removal of Forms and Falsework." Keep all forms for mass placements defined in Section 420.4.0.14, "Mass Placements," in place for 4 days following concrete placement.

3. Placement of Superstructure Members. Do not place superstructure members before the substructure concrete has attained a compressive strength of 3,000 psi.

4. Longitudinal Screeding of Bridge Slabs. Place a longitudinally screed directly on previously placed concrete slabs to check and grade an adjacent slab only after the previously placed slab has aged at least 24 hr. Place and screed the concrete after the previously placed slabs have aged at least 48 hr. Maintain curing of the previously placed slabs during placement.

5. Staged Placement of Bridge Slabs on Continuous Steel Units. When staged placement of a slab is required, ensure that the previously placed concrete attains a compressive strength of 3,000 psi before placing the next stage placement. Multiple stages may be placed in a single day if approved.

6. Storage of Materials on the Structure. Obtain approval to store materials on completed portions of a structure once a compressive strength of 3,000 psi has been attained. Maintain proper curing if materials will be stored on structures before completion of curing.

7. Placement of Equipment and Machinery. Do not place erection equipment or machinery on the structure until the concrete has attained the design strength specified in Section 421.4.A, "Classification and Mix Design," unless otherwise approved.

8. Carting of Concrete. Once the concrete has attained a compressive strength of 3,000 psi, it may be carted, wheeled, or pumped over completed slabs. Maintain curing during these operations.

9. Placing Bridge Rails. Reinforcing steel and concrete for bridge rails may be placed on bridge slabs once the slab concrete has attained a compressive strength of 3,000 psi. If slipforming methods are used for railing concrete, ensure the slab concrete has attained its design strength specified in Section 421.4.A, "Classification and Mix Design," before placing railing concrete.

10. Opening to Construction Traffic. Bridges and direct-traffic culverts may be opened to all construction traffic when the design strength specified in Section 421.4.A, "Classification and Mix Design," has been attained if curing is maintained.

11. Opening to Full Traffic. Bridges and direct-traffic culverts may be opened to the traveling public when the design strength specified in Section 421.4.A, "Classification and Mix Design," has been attained for all structural elements including railing subject to impact from traffic, when curing has been completed for all slabs, and when the concrete surface treatment has been applied in accordance with Item 428, "Concrete Surface Treatment." Obtain approval before opening bridges and direct-traffic culverts to the traveling public, Other noncritical structural and nonstructural concrete may be opened for service upon the completion of curing unless otherwise specified or directed.

12. Post-Tensioned Construction. For structural elements designed to be post-tensioned ensure that strength requirements on the plans are met for stressing and staged loading of structural elements.

13. Backfilling. Backfill in accordance with Section 400.3.C, "Backfill."

B. Plans for Falsework and Forms. Submit 2 copies of plans for falsework and forms for piers, superstructure spans over 20 ft. long, bracing systems for girders when the overhang exceeds 3 ft. 6 in., and bridge widening details. Submit similar plans for other units of the structure as directed. Show all essential details of proposed forms, falsework, and bracing. Have a licensed professional engineer design, seal, and sign

these plans. Department approval is not required, but the Department reserves the right to request modifications to the plans. The Contractor is responsible for the adequacy of these plans.

C. Falsework. Design and construct falsework to carry the maximum anticipated loads safely, including wind loads, and to provide the necessary rigidity. Submit details in accordance with Section 420,4.B, "Plans for Falsework and Forms."

Design job-fabricated falsework assuming a weight of 150 pcf for concrete, and include a liveload allowance of 50 psf of horizontal surface of the form. Do not exceed 125% of the allowable stresses used by the Department for the design of structures.

For commercially produced structural units used in falsework, do not exceed the manufacturer's maximum allowable working loads for moment and shear or end reaction. Include a liveload allowance of 35 psf of horizontal form surface in determining the maximum allowable working load for commercially produced structural units.

Provide timber that is sound, in good condition, and free from defects that would impair its strength. Provide timber that meets or exceeds the species, size, and grade requirements in the submitted falsework plans. Provide wedges made of hardwood or metal in pairs to adjust falsework to desired elevations to ensure even bearing. Do not use wedges to compensate for incorrectly cut bearing surfaces.

Use sills or grillages that are large enough to support the superimposed load without settlement. Take precautions to prevent settling of the supporting material unless the sills or grillages are founded on solid rock, shale, or other hard materials.

Place falsework that cannot be founded on a satisfactory spread footing on piling or drilled shafts with enough bearing capacity to support the superimposed load without settlement. Drive falsework piling to the required resistance determined by the applicable formula in Item 404, "Driving Piling." Design drilled shafts for falsework to carry the superimposed load using both skin friction and point bearing,
Weld in conformance with Item 448, "Structural Field Welding." Securely brace each falsework bent to provide the stiffness required, and securely fasten the bracing to each pile or column it crosses.

Remove falsework when it is no longer required or as indicated on the submitted falsework plan. Pull or cut off foundations for falsework at least 2 ft. below finished ground level. Completely remove falsework, piling, or drilled shafts in a stream, lake, or bay to the approved limits to prevent obstruction to the waterway.

D. Forms. Submit formwork plans in accordance with Section 420.4.B, "Plans for Falsework and Forms."

1. General. Except where otherwise specified or permitted, provide forms of either timber or metal. Design forms for the pressure exerted by a liquid weighing 150 pcf. Take the rate of concrete placement into consideration in determining the depth of the equivalent liquid, Include a liveload allowance of 50 psf of horizontal surface for job-fabricated forms. Do not exceed 125% of the allowable stresses used by the Department for the design of structures.

For commercially produced structural units used for forms, do not exceed the manufacturer's maximum allowable working loads for moment and shear or end reaction, Include a liveload allowance of 35 psf of horizontal form surface in determining the maximum allowable working load for commercially produced structural units. Provide steel forms for round columns unless otherwise approved. Refer to Item 427, "Surface Finishes for Concrete," for additional requirements for off-the-form finishes. Provide

commercial form liners for imprinting a pattern or texture on the concrete surface as shown on the plans and specified in Section 427.4.B.2,d, "Form Liner Finish."

Provide forming systems that are practically mortar-tight, rigidly braced, and strong enough to prevent bulging between supports, and maintain them to the proper line and grade during concrete placement. Maintain forms in a manner that prevents warping and shrinkage. Do not allow offsets at form joints to exceed 1/16 in.

For forms to be left in place, use only material that is inert, nonbiodegradable, and nonabsorptive.

Attachment of forms or screed supports for bridge slabs to steel I-beams or girders may be by welding subject to the following requirements:

- Do not weld to tension flanges or to areas indicated on the plans.
  Weld in accordance with Item 448, "Structural Field Welding."

Take into account:

deflections due to cast-in-place slab concrete and railing shown in the dead load deflection diagram in the setting of slab forms,

- differential beam or girder deflections due to skew angles and the use of certain stay-in-place slab forming systems, and
- deflection of the forming system due to the wet concrete.

For bridge approach slabs, securely stake forms to line and grade and maintain in position. Rigidly attach inside forms for curbs to the outside forms.

Construct all forms to permit their removal without marring or damaging the concrete. Clean all forms and footing areas of any extraneous matter before placing concrete. Provide openings in forms if needed for the removal of laitance or foreign matter

Treat the facing of all forms with bond-breaking coating of composition that will not discolor or injuriously affect the concrete surface, Take care to prevent coating of the reinforcing steel.

Complete all preparatory work before requesting permission to place concrete.

If the forms show signs of bulging or sagging at any stage of the placement, cease placement and remove the portion of the concrete causing this condition immediately if necessary. Reset the forms and securely brace them against further movement before continuing the placement.

2. **Timber Forms.** Provide properly seasoned good-quality lumber that is free from imperfections that would affect its strength or impair the finished surface of the concrete. Provide timber or lumber that meets or exceeds the requirements for species and grade in the submitted formwork plans.

Maintain forms or form lumber that will be reused so that it stays clean and in good condition. Do not use any lumber that is split, warped, bulged, or marred or that has defects that will produce inferior work, and promptly remove such lumber from the work.

Provide form lining for all formed surfaces except:

- the inside of culvert barrels, inlets, manholes, and box girders;
- the bottom of bridge slabs between beams or girders;
- surfaces that are subsequently covered by backfill material or are completely enclosed; and
- any surface formed by a single finished board or by plywood.

Provide form lining of an approved type such as masonite or plywood. Do not provide thin membrane sheeting such as polyethylene sheets for form lining.
Use plywood at least 314 in. thick. Place the grain of the face plies on plywood forms parallel to the span

between the supporting studs or joists unless otherwise indicated on the submitted form drawings.

Use plywood for forming surfaces that remain exposed that meets the requirements for B-B Plyform Class 1 or Class II Exterior of the U.S. Department of Commerce Voluntary Product Standard PS 1.

Space studs and joists so that the facing form material remains in true alignment under the imposed loads.

Space wales closely enough to hold forms securely to the designated lines, scabbed at least 4 ft. on each side of joints to provide continuity. Place a row of wales near the bottom of each placement.

Place facing material with parallel and square joints, securely fastened to supporting studs.

For surfaces exposed to view and receiving only an ordinary surface finish as defined in Section 420.4.M, "Ordinary Surface Finish," place forms with the form panels symmetrical (long dimensions set in the same direction). Make horizontal joints continuous.

Make molding for chamfer strips or other uses of materials of a grade that will not split when nailed and that can be maintained to a true line without warping. Dress wood molding on all faces. Unless otherwise shown on the plans, fill forms at all sharp corners and edges with triangular chamfer strips measuring 314 in. on the sides.

To hold forms in place, use metal form ties of an approved type or a satisfactory substitute of a type that permits ease of removal of the metal. Cut back wire ties at least 112 in. from the face of the concrete.
Use devices to hold metal ties in place that are able to develop the strength of the tie and adjust to allow for proper alignment.

Entirely remove metal and wooden spreaders that separate the forms as the concrete is being placed.

Provide adequate clean-out openings for narrow walls and other locations where access to the bottom of the forms is not readily attainable.

3. **Metal Forms.** Requirements for timber forms regarding design, mortar-tightness, filleted corners, beveled projections, bracing, alignment, removal, reuse, and wetting also apply to metal forms except that metal forms do not require lining unless specifically noted on the plans.

   Use form metal thick enough to maintain the true shape without warping or bulging. Countersink all bolt and rivet heads on the facing sides, Design clamps, pins, or other connecting devices to hold the forms rigidly together and to allow removal without damage to the concrete. Use metal forms that present a smooth surface and that line up properly. Keep metal free from rust, grease, and other foreign materials.

4. **Form Supports for Overhang Slabs**. Form supports that transmit a horizontal force to a steel girder or beam or to a prestressed concrete beam are permitted provided a satisfactory structural analysis has been made of the effect on the girder or beam as indicated in the submitted formwork plans.

   When overhang brackets are used on prestressed concrete beam spans with slab overhangs not exceeding 3 it 6 in., use beam bracing as indicated in the plans. For spans with overhangs exceeding this amount, use additional support for the outside beams regardless of the type of beam used. Submit details of the proposed bracing system in accordance with Section 420.4.13, "Plans for Falsework and Forms."

Punch or drill holes full size in the webs of steel members for support of overhang brackets, or torch-cut them to 114 in, under size and ream them full size, Do not burn the holes full size. Leave the holes open unless otherwise shown on the plans. Never fill the holes by welding.

E. **Drains.** Install and construct weep holes and roadway drains as shown on the plans.

F. **Placing Reinforcement.** Place reinforcement as provided in Item 440, "Reinforcing Steel." Do not weld reinforcing steel supports to I-beams or girders or to reinforcing steel except where shown on the plans,

Place post-tensioning ducts in accordance with the approved prestressing details and in accordance with Item 426, "Prestressing." Keep ducts free of obstructions until all post-tensioning operations are complete.

G. **Placing Concrete.** Give the Engineer sufficient advance notice before placing concrete in any unit of the structure to permit the inspection of forms, reinforcing steel placement, and other preparations,

Follow the sequence of placing concrete shown on the plans or specified.

Do not place concrete when impending weather conditions would impair the quality of the finished work. If conditions of wind, humidity, and temperature are such that concrete cannot be placed without the potential for shrinkage cracking, place concrete in early morning or at night or adjust the placement schedule for more favorable weather. Consult the evaporation rate nomograph in the Portland Cement Association's *Design and Control of Concrete Mixtures* for shrinkage cracking potential. When mixing, placing, and finishing concrete in non-daylight hours, adequately illuminate the entire placement site as approved.

If changes in weather conditions require protective measures after work starts, furnish adequate shelter to protect the concrete against damage from rainfall or from freezing temperatures as outlined in this Item. Continue operations during rainfall only if approved. Use protective coverings for the material stockpiles. Cover aggregate stockpiles only to the extent necessary to control the moisture conditions in the aggregates. Allow at least 1 curing day after the concrete has achieved initial set before placing strain on projecting reinforcement to prevent damage to the concrete.

1. Placing Temperature. Place concrete according to the following temperature limits for the classes of concrete defined in
Section 421.4.A, "Classification and Mix Design":

- Place Class C, F, H, K, or SS concrete only when its temperature at time of placement is between 50 and 95°F. Increase the minimum placement temperature to 60°F if ground-granulated blast furnace (GGBF) slag is used in the concrete.
- When used in a bridge slab or in the top slab of a direct-traffic culvert, place Class CO, DC, or S concrete only when its temperature at the time of placement is between 50 and 85°F. Increase the minimum placement temperature to 60°F if GGBF slag is used in the concrete. The maximum temperature increases to 95°F if these classes are used for other applications.
- Place Class A, B, and D concrete only when its temperature at the time of placement is greater than 50°F.
- Place mass concrete, defined by Section 420.4.G,14, "Mass Placements," only when its temperature at the time of placement is between 50 and 75°F.

2. Transporting Time. Place concrete delivered in agitating trucks within 60 min. after batching. Place concrete delivered in nonagitating equipment within 45 min. after hatching. Revise the concrete mix design as necessary for hot weather or other conditions that contribute to quick setting of the concrete. Submit for approval a plan to demonstrate that these time limitations can be extended while ensuring the concrete can be properly placed, consolidated, and finished without the use of additional water.

3. Workability of Concrete. Place concrete with a slump as specified in Section 421.4.A.5, "Slump." Concrete that exceeds the maximum slump will be rejected. Water may be added to the concrete before discharging any concrete from the truck to adjust for low slump provided that the maximum mix design water-cement ratio is not exceeded. After introduction of any additional water or chemical admixtures, mix concrete in accordance with Section 421.4.E, "Mixing and Delivering Concrete." Do not add water or chemical admixtures after any concrete has been discharged.

4. Transporting Concrete. Use a method and equipment capable of maintaining the rate of placement shown on the plans or required by this Item to transport concrete to the forms. Transport concrete by buckets,

chutes, buggies, belt conveyors, pumps, or other methods.

Protect concrete transported by conveyors from sun and wind to prevent loss of slump and workability, Shade or wrap with wet burlap pipes through which concrete is pumped as necessary to prevent loss of slump and workability.

Arrange and use chutes, troughs, conveyors, or pipes so that the concrete ingredients will not be separated. When necessary to prevent segregation, terminate such equipment in vertical downspouts. Extend open troughs and chutes, if necessary, down inside the forms or through holes left in the forms.

Keep all transporting equipment clean and free from hardened concrete coatings. Discharge water used for cleaning clear of the concrete.

5. Preparation of Surfaces. Thoroughly wet all forms, prestressed concrete panels, T-beams, and concrete box beams on which concrete is to be placed before placing concrete on them. Remove any remaining puddles of excess water before placing concrete. Provide surfaces that are in a moist, saturated surface-dry condition when concrete is placed on them.

Ensure that the subgrade or foundation is moist before placing concrete for bridge approach slabs or other concrete placed on grade, Lightly sprinkle the subgrade if dry.

6. Expansion Joints. Construct joints and devices to provide for expansion and contraction in accordance with plan details and the requirements of this Section and Item 454, "Bridge Expansion Joints."
Prevent bridging of concrete or mortar around expansion joint material in bearings and expansion joints.
Use forms adaptable to loosening or early removal in construction of all open joints and joints to be filled with expansion joint material. To avoid expansion or contraction damage to the adjacent concrete, loosen these forms as soon as possible after final concrete set to permit free movement of the span without requiring full form removal.

When the plans show a Type A joint, provide preformed fiber joint material in the vertical joints of the roadway slab, curb, median, or sidewalk, and fill the top 1 in. with the specified joint sealing material unless noted otherwise, Install the sealer in accordance with Item 438, "Cleaning and Sealing Joints and Cracks (Rigid Pavement and Bridge Decks)," and the manufacturer's recommendations. Use light wire or nails to anchor any preformed fiber joint material to the concrete on 1 side of the joint.

Ensure that finished joints conform to the plan details with the concrete sections completely separated by the specified opening or joint material.

Remove all concrete within the joint opening soon after form removal and again where necessary after surface finishing to ensure full effectiveness of the expansion joint.

7. Construction Joints. A construction joint is the joint formed by placing plastic concrete in direct contact with concrete that has attained its initial set. Monolithic placement means that the manner and sequence of concrete placing does not create a construction joint.

Make construction joints of the type and at the locations shown on the plans. Do not make joints in bridge slabs not shown on the plans unless approved. Additional joints in other members are not permitted without approval. Place authorized additional joints using details equivalent to those shown on the plans for joints in similar locations.

Unless otherwise required, make construction joints square and normal to the forms. Use bulkheads in the forms for all vertical joints.

Thoroughly roughen the top surface of a concrete placement terminating at a horizontal construction joint as soon as practical after initial set is attained.

Thoroughly clean the hardened concrete surface of all loose material, laitance, dirt, and foreign matter, and saturate it with water. Remove all free water and moisten the surface before concrete or bonding grout is placed against it.

Draw forms tight against the existing concrete to avoid mortar loss and offsets at joints.

Coat the joint surface with bonding mortar, grout, epoxy, or other material as indicated in the plans or other Items. Provide Type V epoxy per DMS-6100, "Epoxies and Adhesives," for bonding fresh concrete to hardened concrete. Place the bonding epoxy on a clean, dry surface, and place the fresh concrete while the epoxy is still tacky. Place bonding mortar or grout on a surface that is saturated surface-dry, and place the concrete. before the bonding mortar or grout dries. Place other bonding agents in accordance with the manufacturer's recommendations.

8. Handling and Placing. Minimize segregation of the concrete and displacement of the reinforcement when handling and placing concrete. Produce a uniform dense compact mass.

Do not allow concrete to free-fall more than 5 ft. except in the case of drilled shafts, thin walls such as in culverts, or as allowed by other Items. Remove any hardened concrete splatter ahead of the plastic concrete.
Fill each part of the forms by depositing concrete as near its final position as possible. Do not deposit large quantities at 1 point and run or work the concrete along the forms.

Deposit concrete in the forms in layers of suitable depth but not more than 36 in. deep unless otherwise permitted. Avoid cold joints in a monolithic placement, Sequence successive layers or adjacent portions of concrete so that they can be vibrated into a homogeneous mass with the previously placed concrete before it sets. When re-vibration of the concrete is shown on the plans, allow at most 1 hr. to elapse between adjacent or successive placements of concrete except as otherwise allowed by an approved placing procedure. This time limit may he extended by 112 hr, if the concrete contains at least a normal dosage of retarding admixture.

Use an approved retarding agent to control stress cracks and cold joints in placements where differential settlement and setting time may induce cracking.

9. Consolidation. Carefully consolidate concrete and flush mortar to the form surfaces with immersion type vibrators, Do not use vibrators that operate by attachment to forms or reinforcement except where approved on steel forms.

Vibrate the concrete immediately after deposit. Systematically space points of vibration to ensure complete consolidation and thorough working of the concrete around the reinforcement, embedded fixtures, and into the corners and angles of the forms. Insert the vibrator vertically where possible except for slabs where it may be inserted in a sloping or horizontal position. Vibrate the entire depth of each lift, allowing the vibrator to penetrate several inches into the preceding lift. Do not use the vibrator to move the concrete to other locations in the forms. Do not drag the vibrator through the concrete. Thoroughly consolidate concrete along construction joints by

operating the vibrator along and close to but not against the joint surface. Continue the vibration until the concrete surrounding reinforcements and fixtures is completely consolidated. Hand-spade or rod the concrete if necessary to ensure flushing of mortar to the surface of all forms.

10. Installation of Dowels and Anchor Bolts. Install dowels and anchor bolts by casting them in-place or by grouting with grout, epoxy, or epoxy mortar unless noted otherwise. Form or drill holes for grouting.

Drill holes for anchor bolts to accommodate the bolt embedment required by the plans. Make holes for dowels at least 12 in. deep unless otherwise shown on the plans. When using grout or epoxy mortar, make the diameter of the hole at least twice the dowel or bolt diameter, but the hole need not exceed the dowel or bolt diameter diameter plus 1-½ in. When using epoxy, make the hole diameter 1/16 to ¼ in. greater than the dowel or bolt diameter.

Thoroughly clean holes of all loose material, oil, grease, or other bond-breaking substance, and blow them clean with filtered compressed air. Ensure that holes are in a surface dry condition when epoxy type material is used and in a surface moist condition when hydraulic cement grout is used. Develop and demonstrate for approval a procedure for cleaning and preparing the holes for installation of the dowels and anchor bolts. Completely fill the void between the hole and dowel or bolt with grouting material. Follow exactly the requirements for cleaning outlined in the product specifications for prepackaged systems.

For cast-in-place or grouted systems, provide hydraulic cement grout in accordance with Section 421..2.F, "Mortar and Grout," epoxy, epoxy mortar, or other prepackaged grouts as approved. Provide a Type III epoxy per DMS-6100, "Epoxies and Adhesives," when neat epoxy is used for anchor bolts or dowels. Provide Type VIII epoxy per DMS-6100 when an epoxy grout is used. Provide grout, epoxy, or epoxy mortar as the binding agent unless otherwise indicated on the plans.

Provide other anchor systems as required in the plans.

11. Placing Concrete in Cold Weather. Protect concrete placed under weather conditions where weather may adversely affect results. Permission given by the Engineer for placing during cold weather does not relieve the Contractor of responsibility for producing concrete equal in quality to that placed under normal conditions. If concrete placed under poor conditions is unsatisfactory, remove and replace it as directed at Contractor's expense.

Do not place concrete in contact with any material coated with frost or having a temperature of 32° F or lower. Do not place concrete when the ambient temperature in the shade is below 40°F and falling unless approved. Concrete may be placed when the ambient temperature in the shade is 35°F and rising or above 40°F. Provide and install recording thermometers, maturity meters, or other suitable temperature measuring devices to verify that all concrete is effectively protected as follows:

- Maintain the temperature of the top surface of bridge slabs and top slabs of direct-traffic culverts at 50°F or above for 72 hr. from the time of placement and above 40°F for an additional 72 hr.
- Maintain the temperature at all surfaces of concrete in bents, piers, culvert walls, retaining walls, parapets, wingwalls, bottoms of bridge slab or culvert top slabs, and other similar formed concrete at 40°F or above for 72 hr. from the time of placement,
- Maintain the temperature of all other concrete, including the bottom slabs (footings) of culverts, placed on or in the ground above 32°F for 72 hr. from the time of placement.

Use additional covering, insulated forms, or other means and, if necessary, supplement the covering with

artificial heating. Avoid applying heat directly to concrete surfaces. Cure as specified in Section 420.4.J, "Curing Concrete," during this period until all requirements for curing have been satisfied.
When impending weather conditions indicate the possible need for temperature protection, have on hand all necessary heating and covering material, ready for use, before permission is granted to begin placement.

12. Placing Concrete in Hot Weather. Use an approved retarding agent in all concrete for superstructures and top slabs of direct-traffic culverts, except concrete containing GGBF slag, when the temperature of the air is above 85°F unless otherwise directed.

Keep the concrete at or below the maximum temperature at time of placement as specified in Section 420.4.0.1, "Placing Temperature," Sprinkle and shade aggregate stockpiles or use ice, liquid nitrogen systems, or other approved methods as necessary to control the concrete temperature.

13. Placing Concrete in Water. Deposit concrete in water only when shown on the plans or with approval. Make forms or cofferdams tight enough to prevent any water current passing through the space in which the concrete is being deposited. Do not pump water during the concrete placing or until the concrete has set for at least 36 hr.

Place the concrete with a tremie or pump, or use another approved method, and do not allow it to fall freely through the water or disturb it after it is placed. Keep the concrete surface approximately level during placement.

Support the tremie or operate the pump so that it can be easily moved horizontally to cover all the work area and vertically to control the concrete flow. Submerge the lower end of the tremie or pump hose in the concrete at all times. Use continuous placing operations until the work is complete.

For concrete to be placed under water, design the concrete mix in accordance with Item 421, "Hydraulic Cement Concrete," with a minimum cement content of 650 lb. per cubic yard. Include an anti-washout admixture in the mix design as necessary to produce a satisfactory finished product.

14. Mass Placements. Mass placements are defined as placements with a least dimension greater than or equal to 5 ft., or designated on the plans. For monolithic mass placements, develop and obtain approval for a plan to ensure the following during the heat dissipation period:

· the temperature differential between the central core of the placement and the exposed concrete surface does not exceed 35°F and
· the temperature at the central core of the placement does not exceed 160°F.

Base this plan on the equations given in the Portland Cement Association's *Design and Control of Concrete Mixtures.* Cease all mass placement operations and revise the plan as necessary if either of the above limitations is exceeded.

Include a combination of the following elements in this plan:

- selection of concrete ingredients including aggregates, gradation, and cement types, to minimize heat of hydration;
- use of ice or other concrete cooling ingredients;
- use of liquid nitrogen dosing systems;
- controlling rate or time of concrete placement;
- use of insulation or supplemental external heat to control heat loss;
- use of supplementary cementing materials; or
- use of a cooling system to control the core temperature.

Furnish and install 2 sets of temperature recording devices, maturity meters, or other approved equivalent

devices at designated locations. Use these devices to simultaneously measure the temperature of the concrete at the core and the surface. Maintain temperature control methods for 4 days unless otherwise approved. Maturity meters may not be used to predict strength of mass concrete.

15. **Placing Concrete in Foundation and Substructure.** Do not place concrete in footings until the depth and character of the foundation has been inspected and permission has been given to proceed.

Placing of concrete footings upon seal concrete is permitted after the cofferdams are free from water and the seal concrete cleaned. Perform any necessary pumping or bailing during the concreting from a suitable sump located outside the forms.

Construct or adjust all temporary wales or braces inside cofferdams as the work proceeds to prevent unauthorized construction joints,

When footings can be placed in a dry excavation without the use of cofferdams, omit forms if approved, and fill the entire excavation with concrete to the elevation of the top of footing.

Place concrete in columns monolithically between construction joints unless otherwise directed. Columns and caps or tie beams supported on them may be placed in the same operation or separately. If placed in the same operation, allow for settlement and shrinkage of the column concrete by placing it to the lower level of the cap or tie beam, and delay placement between 1 and 2 hr. before proceeding with the cap or tie beam placement.

16. Placing Concrete in Box Culverts. Where the top slab and walls are placed monolithically in culverts more than 4 ft. in clear height, allow between 1 and 2 hr. to elapse before placing the top slab to allow for settlement and shrinkage in the wall concrete.

Accurately finish the footing slab at the proper time to provide a smooth uniform surface. Finish top slabs that carry direct-traffic as specified in this Item, Give top slabs of fill type culverts a float finish.

17. **Placing Concrete in Superstructure.** Unless otherwise shown on the plans, place simple span bridge slabs without transverse construction joints by using either a self-propelled transverse finishing machine or a mechanical longitudinal screed. For small placements or for unusual conditions such as narrow widening, variable cross-slopes, or transitions, use of manually operated screeding equipment may be permitted. Support the screed adequately on a header or rail system stable enough to withstand the longitudinal or lateral thrust of the equipment. Adjust the profile grade line as necessary to account for variations in beam camber and other factors to obtain the required slab thickness and concrete cover over the slab reinforcement. Set beams and verify their surface elevations in a sufficient number of spans so that when adjustment is necessary, the profile grade line can be adjusted over suitable increments to produce a smooth riding surface. Take dead load deflection into account in setting the grades of headers and rail systems. Use construction joints, when required or permitted for slab placements on steel or prestressed concrete beams, as shown on the plans. Before placing concrete on steel girder or truss spans, release falsework under the spans and swing the spans free on their permanent supports.

Make 1 or more passes with the screed over the bridge slab segment before placing concrete on it to ensure proper operation and maintenance of grades and clearances. Use an approved system of checking to detect any vertical movement of the forms or falsework. Maintain forms for the bottom surface of concrete slabs, girders, and overhangs to the required vertical alignment during concrete placing.

Fog unformed surfaces of slab concrete in bridge slabs and in top slabs of direct-traffic culverts from the time of initial strikeoff of the concrete until finishing is completed and required interim during is in place, Do not use fogging as a means to add finishing water, and do not work moisture from the fog spray into the fresh concrete.

For simple spans, retard the concrete only if necessary to complete finishing operations or as required by this Section. When filling curb forms, bring the top of curb and sidewalk section to the correct camber and alignment, and finish them as described in this Item.

a. Transverse Screeding. Install rails for transverse finishing machines that are supported from the beams or girders so that the supports may be removed without damage to the slab. Prevent bonding between removable supports and the concrete in an acceptable manner. Do not allow rail support parts that remain embedded in the slab to project above the upper mat of reinforcing steel. Rail or screed supports attached to I-beams or girders are subject to the requirements of this Item. Unless otherwise shown on the plans, for transverse screeding the minimum rate of concrete placement is 30 linear feet of bridge slab per hour. Deposit concrete parallel to the skew of the bridge so that all girders are loaded uniformly along their length. Deposit slab concrete between the exterior beam and the adjacent beam before placing concrete in the overhang portion of the slab. Furnish personnel and equipment capable of placing, finishing, and curing the slab at an acceptable rate to ensure compliance with the specifications, Place concrete in transverse strips. On profile grades greater than 1-½%, start placement at the lowest end.

b. Longitudinal Screeding. Unless otherwise shown on the plans, use of temporary intermediate headers will be permitted for placements over 50 ft. long if the rate of placement is rapid enough to prevent a cold joint and if these headers are designed for easy removal to permit satisfactory consolidation and finish of the concrete at their locations. Deposit slab concrete between the exterior beam and the

adjacent beam before placing concrete in the overhang portion of the slab. Place concrete in longitudinal strips starting at a point in the center of the segment adjacent to 1 side except as this Section indicates, and complete the strip by placing uniformly in both directions toward the ends. For spans on a profile grade of 1-½%or more, start placing at the lowest end. Use strips wide enough that the concrete within each strip remains plastic until placement of the adjacent strip. Where monolithic curb construction is specified, place the concrete in proper sequence to be monolithic with the adjacent longitudinal strips of the slabs.

c. Placements on Continuous Steel Units. Unless otherwise shown on the plans, place slabs on continuous steel units in a single continuous operation without transverse construction joints using a self-propelled transverse finishing machine or a mechanical longitudinal screed. Retard the initial set of the concrete sufficiently to ensure that concrete remains plastic in at least 3 spans immediately preceding the slab being placed. Use construction joints, when required for slab placements on steel beams or girders, as shown on the plans. When staged placement of a slab is required in the plans, ensure that the previously placed concrete attains a compressive strength of 3,000 psi before placing the next stage concrete. Multiple stages may be placed in a single day if approved. Where plans permit staged placing without specifying a particular order of placement, use an approved placing sequence that will not overstress of any of the supporting members.

d. Slab and Girder Units. Unless otherwise shown on the plans, place girders, slab, and curbs of slab and girder spans monolithically. Fill concrete girder stems first, and place the slab concrete within the time limits specified in this Item. If using a t[r]ansverse screed, place concrete in the stems for a short distance and then place the concrete in transverse strips. If using a longitudinal screed, fill the outside girder stem first, beginning at the low end or side, and continue placement in longitudinal strips.

H. Treatment and Finishing of Horizontal Surfaces Other Than Bridge Slabs. Strike off to grade and finish all unformed upper surfaces. Do not use mortar topping for surfaces constructed under this Section.

After the concrete has been struck off, float the surface with a suitable float, Give bridge sidewalks a wood float or broom finish, or stripe them with a brush.

Slightly slope the tops of caps and piers between bearing areas from the center toward the edge, and slope the tops of abutment and transition bent caps from the backwall to the edge, as directed, so that water drains from the surface. Give the concrete a smooth trowel finish, Construct bearing areas for steel units in accordance with Section 441.3.1C.5, "Bearing and Anchorage Devices." Give the bearing area under the expansion ends of concrete slabs and slab and girder spans a steel-trowel finish to the exact grades required. Give bearing areas under elastomeric bearing pads or nonreinforced bearing seat buildups a textured, wood float finish. Do not allow the bearing area to vary from a level plane more than 1116 in. in all directions.

Cast bearing seat buildups or pedestals for concrete units integrally with the cap or with a construction joint. Provide a latex-based mortar, an epoxy mortar, or an approved proprietary bearing mortar for bearing seat buildups cast with a construction joint. Mix mortars in accordance with the manufacturer's recommendations. Construct pedestals of Class C concrete, reinforced as shown on the plans or as indicated in Figure 1 and Figure 2.

I. Finish of Bridge Slabs. Provide camber for specified vertical curvature and transverse slopes.

For concrete flat slab and concrete slab and girder spans cast in place on falsework, provide additional camber to offset the initial and final deflections of the span as indicated in the plans. For concrete slab and girder spans using pan forms, provide camber of approximately 318 in. for 30-ft. spans and 112 in. for 40-ft, spans to offset initial and final deflections unless otherwise directed. For concrete flat slab and concrete slab and girder spans not using pan forms, when dead load deflection is not shown on the plans, provide a camber of 1/8 in. per 10 ft. of span length but no more than ½ in.

Provide a camber of 114 in, in addition to deflection for slabs without vertical curvature on steel or prestressed concrete beams,

Use work bridges or other suitable facilities to perform all finishing operations and to provide access, if necessary, for the Engineer to check measurements for slab thickness and reinforcement cover. As soon as the concrete has been placed and vibrated in a section wide enough to permit working, level, strike off, and screed the surface, carrying a slight excess of concrete ahead of the screed to fill all low spots.

Move longitudinal screeds across the concrete with a saw-like motion while their ends rest on headers or templates set true to the roadway grade or on the adjacent finished slab, Move transverse screeds longitudinally approximately 115 of the drum length for each complete out-and-back pass of the carriage.

Screed the surface of the concrete enough times and at intervals to produce a uniform surface true to grade and free of voids.

Work the screeded surface to a smooth finish with a long-handled wood or metal float or hand-float it from work bridges over the slab. Floating may not be necessary if the pan float attached to a transverse screed produces an acceptable finish, Avoid overworking the surface of the concrete. Avoid overuse of finish water.

Perform sufficient checks, witnessed by the Engineer, with a longhandled 16-ft. straightedge on the plastic concrete to ensure that the final surface will be within specified tolerances. Make the check with the straightedge parallel to the centerline, Lap each pass half over the preceding pass. Remove all high spots, and fill and float all depressions over 1/16 in. deep with fresh concrete. Continue checking and floating until the surface is true to grade and free of depressions, high spots, voids, or rough spots. Fill screed-rail support with holes with concrete, and finish them to match the top of the slab.

Finish the concrete surface to a uniform texture using a carpet drag, burlap drag, or broom finish. Finish the surface to a smooth sandy texture without blemishes, marks, or scratches deeper than 1/16 in. Apply the surface texturing using a work bridge or platform immediately after completing the straightedge checks. Draw the carpet or burlap drag longitudinally along the concrete surface, adjusting the surface contact area or pressure to provide a satisfactory coarsely textured surface. A broom finish may be performed using a fine bristle broom transversely.

Coat the concrete surface immediately after the carpet or burlap drag, or broom finish with a single application of evaporation retardant at a rate recommended by the manufacturer. Do not allow more than 10 min. to elapse between the texturing at any location and application of evaporation retardant. The evaporation retardant may be applied using the same work bridge used for surface texturing. Do not work the concrete surface once the evaporation retardant has been applied.

Apply interim and final curing in accordance with Section 420.4.J, "Curing Concrete."

The Contractor is responsible for the ride quality of the finished bridge slab. The Engineer will use a 10-ft. straightedge (1/8 in. in 10 ft.) to verify ride quality and to determine locations where corrections are needed. If the Engineer determines that the ride quality is unacceptable, submit a plan for approval to produce a ride of acceptable quality. Make all corrections for ride before saw-cutting grooves.

Saw-cut grooves in the hardened concrete of bridge slabs, bridge approach slabs, and direct-traffic culverts to produce the final texturing after completion of the required curing period. Cut grooves perpendicular to the structure centerline. Cut grooves continuously across the slab to within 18 in. of the barrier rail, curb, or median divider. At skewed metal expansion joints in bridge slabs, adjust groove cutting by using narrow-width cutting heads so that all grooves end within 6 in. of the joint, measured perpendicular to the centerline of the metal joint. Leave no ungrooved surface wider than 6 in. adjacent to either side of the joint. Ensure that the minimum distance to the first groove, measured perpendicular to the edge of the concrete joint or from the junction between the concrete and the metal leg of the joint, is 1 in. Cut grooves continuously across construction joints or other joints in the concrete that are less than 1/2 in. wide. Apply the same procedure described above where barrier rails, curbs, or median dividers are not parallel to the structure centerline to maintain the 18-in. maximum dimension from the end of the grooves to the gutter line. Cut grooves continuously across formed concrete joints.

When the plans call for a concrete overlay to be placed on the slab (new construction) or on prestressed concrete box beams or other precast elements, give a carpet drag, burlap drag, or broom finish to all concrete surfaces to be overlaid. Saw-grooving is not required in this case. Provide an average texture depth for the finish of approximately 0.035 in, with no individual test falling below 0.020 in., unless otherwise shown on the plans, when tested in accordance with Tex-436-A. If the texture depth falls below what is intended, revise finishing procedures to produce the desired texture.

When the plans require an asphalt seal, with or without overlay, on the slab (new construction), on prestressed concrete box beams, or on other precast elements, give all concrete surfaces to be covered a lightly textured broom or carpet drag finish. Provide an average texture depth of approximately 0.025 in. when tested in accordance with Tex-436-A.

J. Curing Concrete. Obtain approval of the proposed curing methods, equipment, and materials before placing concrete. The Engineer may require the same curing methods for like portions of a single structure. Inadequate curing or facilities may delay all concrete placement on the job until remedial action is taken.

A curing day is a calendar day when the temperature, taken in the shade away from artificial heat, is above 50°F for at least 19 hr. or, on colder days if the temperature of all surfaces of the concrete is maintained above 40°F, for the entire 24 hr. The required curing period begins when all concrete has attained its initial set. Tex-440-A may be used to determine when the concrete has attained its initial set.

Cure all concrete for 4 consecutive days except as noted in Table 1.

Table 1
Exceptions to 4-Day Curing

Description	Type of Cement	Required Curing Days
Upper surfaces of bridge slabs, top slab of direct-traffic culverts, and concrete overlays	I or III	8
	II or 1/11	10
	All types with supplementary cementing materials	10
Concrete piling buildups	All	6

For upper surfaces of bridge slabs, bridge approach slabs, median and sidewalk slabs, and culvert top slabs constructed using Class S concrete, apply interim curing using a Type 1-D curing compound as soon as possible after application of the evaporation retardant and after the water sheen has disappeared, but no more than 45 min. after application of the evaporation retardant. Apply membrane interim curing using a work bridge or other approved apparatus to ensure a uniform application. Water-cure for final curing in accordance with this Section, starting as soon as possible without damaging the surface finish. Maintain the water curing for the duration noted in Table 1.

Place polyethylene sheeting, burlap-polyethylene blankets, laminated mats, or insulating curing mats in direct contact with the slab when the air temperature is expected to drop below 40°F during the first 72 hr. of the curing period. Weigh down these curing materials with dry mats to maintain direct contact with the concrete and to provide insulation against cold weather. Supplemental heating or insulation may be required in cold and wet weather if the insulating cotton mats become wet or if the concrete drops below the specified curing temperature. Avoid applying heat directly to concrete surfaces.

For the top surface of any concrete unit upon which concrete is to be placed and bonded at a later interval (stub walls, risers, etc.) and other superstructure concrete (curbs, wingwalls, parapet walls, etc.), use only water curing in accordance with this Section.

Cure all other concrete as specified in the pertinent Items. Use the following methods for curing concrete, subject to the requirements of this Item.

1. Form Curing. When forms are left in intimate contact with the concrete, other curing methods are not required except for exposed surfaces and for cold weather protection. If forms are removed before the 4-day required curing period, use another approved curing method.

2. Water Curing. Keep all exposed surfaces of the concrete wet continuously for the required curing time. Use water curing that meets the requirements for concrete mixing water in Section 421.2.D, "Water." Do not use seawater or water that stains or leaves an unsightly residue.

a. Wet Mats. Keep the concrete continuously wet by maintaining wet cotton mats in direct contact with the concrete for the required curing time, If needed, place damp burlap blankets made from 9-oz. stock on the damp concrete surface for temporary protection before applying cotton mats. Then place the dry mats and wet them immediately after they are placed. Weight the mats adequately to provide continuous contact with all concrete. Cover surfaces that cannot be cured by direct contact with mats, forming an enclosure well anchored to the forms or ground so that outside air cannot enter the enclosure. Provide sufficient moisture inside the enclosure to keep all surfaces of the concrete wet.

b. Water Spray. Overlap sprays or sprinklers to keep all unformed surfaces continuously wet.

c. Ponding. Cover the surfaces with at least 2 in. of clean granular material, kept wet at all times, or at least 1 in. deep water. Use a dam to retain the water or saturated granular material.

3. Membrane Curing. Unless otherwise shown on the plans, choose either Type 1-D or Type 2 membrane-curing compound when membrane curing is permitted. Type 1-D (Resin Base Only) is required for interim curing bridge slabs and top slabs of direct traffic culverts and all other surfaces that require a higher grade of surface finish. For substructure concrete provide only 1 type of curing compound on any 1 structure.

Apply membrane curing just after free moisture has disappeared at a rate of approximately 180 sq. ft. per gallon, Do not spray curing compound on projecting reinforcing steel or concrete that will later form a construction joint. Do not apply membrane curing to thy surfaces, Dampen formed surfaces and surfaces that have been given a first rub so that they are moist at the time of application of the membrane.

When membrane is used for complete curing, leave the film unbroken for the minimum curing period specified. Correct damaged membrane immediately by reapplication of membrane. Polyethylene sheeting, burlap-polyethylene mats, or laminated mats in close contact with the concrete surfaces are equivalent to membrane curing.

K. Removal of Forms and Falsework. Unless otherwise directed, forms for vertical surfaces may be removed after the concrete has aged 12 hr. after initial set provided the removal can be done without damage to the concrete. Keep forms for mass placements, defined in Section 420,4,G.14, "Mass Placements," in place for 4 days following concrete placement.

Remove forms for inside curb faces and for bridge rails whenever removal can be done without damage to the curb or railing.

Leave in place weight-supporting forms and falsework spanning more than 1 ft. for all bridge components and culvert slabs except as directed otherwise until the concrete has attained a compressive strength of 2,500 psi. Remove forms for other structural components as necessary.

Remove inside forms (walls and top slabs) for box culverts and sewers after concrete has attained a compressive strength of 1,800 psi if an approved overhead support system is used to transfer the weight of the top slab to the walls of the box culvert or sewer before removal of the support provided by the forms.

Forms or parts of forms may be removed only if constructed to permit removal without disturbing forms or falsework required to be left in place for a longer period on other portions of the structure.
Remove all metal appliances used inside forms for alignment to a depth of at least 112 in. from the concrete surface. Make the appliances so that metal may be removed without undue chipping or spalling of the concrete, and so that it leaves a smooth opening in the concrete surface when removed. Do not burn off rods, bolts, or ties.

Remove all forms and falsework unless otherwise directed.

L. Defective Work. Repair defective work as soon as possible. Remove and replace at the expense of the Contractor any defect that cannot be repaired to the satisfaction of the Engineer.

M. Ordinary Surface Finish, Apply an ordinary surface finish to all concrete surfaces as follows:

- Chip away all loose or broken material to sound concrete where porous, spalled, or honeycombed areas are visible after form removal.
- Repair spalls by saw-cutting and chipping at least 1/2 in. deep, perpendicular to the surface to eliminate feather edges. Repair shallow cavities using a latex adhesive grout, cement mortar, or epoxy mortar as approved. Repair large areas using concrete as directed or approved.

- Clean and fill holes or spalls caused by the removal of form ties, etc., with latex grout, cement grout, or epoxy grout as approved. Fill only the holes. Do not blend the patch with the surrounding concrete. On surfaces to receive a rub finish in accordance with Item 427, "Surface Finishes for Concrete," chip out exposed parts of metals chairs to a depth of 112 in. and repair the surface.

- Remove all fins, runs, drips, or mortar from surfaces that will be exposed. Smooth all form marks and chamfer edges by grinding or dry-rubbing.
- Ensure that all repairs are dense, well bonded, and properly cured. Finish exposed large repairs to blend with the surrounding concrete where a higher class of finish is not specified.

Unless noted otherwise, apply an ordinary surface finish as the final finish to the following exposed surfaces:

- inside and top of inlets,
- inside and top of manholes,
- inside of sewer appurtenances,
- inside of culvert barrels,
- bottom of bridge slabs between girders or beams, and
- vertical and bottom surfaces of interior concrete beams or girders.

Form marks and chamfer edges do not need to be smoothed for the inside of culvert barrels and the bottom of bridge slabs between girders or beams.

ITEM 440
REINFORCING STEEL

440.1. Description. Furnish and place reinforcing steel of the sizes and details shown on the plans.

440.2. Materials.

A. Approved Mills. Before furnishing steel, producing mills of reinforcing steel for the Department must be pre-approved in accordance with DMS-7320, "Qualification Procedure for Reinforcing Steel Mills," by the Construction Division, which maintains a list of approved producing mills. Reinforcing steel obtained from unapproved sources will not be accepted.

B. Deformed Bar And Wire Reinforcement. Unless otherwise shown on the plans, reinforcing steel must be Grade 60, and bar reinforcement must be deformed. Reinforcing steel must conform to one of the following:

- A,ST'M A 615, Grades 40 or 60;
- ASTM A 996, Type A, Grades 40 or 60;
- ASTM A 996, Type R, Grade 60, permitted in concrete pavement only (Furnish ASTM A 996, Type R. bars as straight bars only and do not bend them,):lend tests are not required.), or
- ASTMA 706.

The provisions of this Item take precedence over ASTM provisions.

The nominal size, area, and weight of reinforcing steel bars covered by this Item are shown in Table 1. Designate smooth bars up to No. 4 by size number and above No, 4 by diameter in inches.

Table 1

Size$_s$ Area, and Weight of Reinforcing Steel Bars

Bar Size Number (in.)	Bar Size Number (ram)	Diameter (in.)	Area (Sq. in.)	Weight per Ft.
3	10	0.375	0,11	0.376
4	13	0.504	0.20	0.668
5	16	0.625	0.31	1.043
6	19	0.750	0.44	1.502
7	22	0.875	0.60	2.044
8	25	1.000	0.79	2.670
9	29	1.128	1.00	3.400
10	32	1.270	1.27	4.303
11	36	1.410	1.56	5.313
14	43	1.693	2.25	7.650
18	57	2.257	4.00	13.60

Note: Bar size numbers (in.) are based un the number of eighths of an inch included in the nominal diameter of the bar. Bar size numbers (mm) approximate the number of millimeters included in the nominal diameter of the bar.

C. Smooth Bar and Spiral Reinforcement. Smooth bars and dowels for concrete pavement must have a minimum yield strength of 60 ksi and meet ASTM A 615. For smooth bars that are larger than No. 3, provide steel conforming to ASTM A 615 or meet the physical requirements of ASTM A 36.

Spiral reinforcement may be smooth or deformed bars or wire of the minimum size or gauge shown on the plans. Bars for spiral reinforcement must comply with ASTM A 615, Grade 40; ASTM A 996, Type A, Grade 40; or ASTM A 675, Grade 80, meeting dimensional requirements of ASTM A 615, Smooth wire must comply with ASTM A 82, and deformed wire must comply with ASTM A 496.

D. Weldable Reinforcing Steel. Reinforcing steel to be welded must comply with ASTM A 706 or have a carbon equivalent (C.E,) of at most 0.55%. A report of chemical analysis showing the percentages of elements necessary to establish C.E. is required for reinforcing steel that does not meet ASTM A 706 to be structurally welded, These requirements do not pertain to miscellaneous welds on reinforcing steel as defined in Section 448.4.B.t.a, "Miscellaneous Welding Applications."

Calculate C.E. using the the following formula:

$$C.E. = \%C + \frac{\%Mn}{6} + \frac{\%Cu}{40} + \frac{\%Ni}{20} + \frac{\%Cr}{10} - \frac{\%Mo}{50} _ \frac{\%V}{10}$$

L. Welded Wire Fabric. For fabric reinforcement, use wire that conforms to ASTM A 82 or A 496. Use wire fabric that conforms to ASTM A 185 or A 497. Observe the relations shown in Table 2 among size number, diameter in inches, and area when ordering wire by size numbers, unless otherwise specified. Precede the size number for deformed wire with "D" and for smooth wire with "W."

Designate welded wire fabric as shown in the following example; 6 x 12 - W16 x W8 (indicating 6-in. longitudinal wire spacing and 12-in. transverse wire spacing with smooth No. 16 wire longitudinally and smooth No, 8 wire transversely).

Table 2
Wire Size Number Diameter, and Area

Size Number (in.)	Size Number (mm)	Diameter (inc.)	Area (sq. in.)
31	200	0.628	0.310
30	194	0.618	0.300
28	181	0.597	0.280
26	168	0.575	0.260
24	155	0.553	0.240
22	142	0.529	0.220
20	129	0.505	0.200
18	116	0.479	0.180
16	103	0.451	0.160
14	90	0.422	0.140
12	77	0.391	0.120
10	65	0.357	0.100
8	52	0.319	0.080
7	45	0.299	0.070
6	39	0.276	0.060
5.5	35	0.265	0.055
5	32	0.252	0.050
4.5	29	0.239	0.045
4	26	0.226	0.040
3.5	23	0.211	0.035
2.9	19	0.192	0.035
2.5	16	0.178	0.025
2	13	0.160	0.020
1.4	9	0.134	0.014
1.2	8	0.124	0.012
0.5	3	0.080	0.005

Note. Size numbers (in.) are the nominal cross-sectional area of the wire in hundredths of a square inch. Size numbers (mm) tire the nominal Gross sectional area of the wire in square millimeters. Fractional sizes between the sizes listed above ore also available and acceptable for use.

F. Epoxy Coating. Epoxy coating will he required as shown on the plans. Before furnishing epoxy-coated reinforcing steel, an epoxy applicator must be pre-approved in accordance with OMS-7330, "Qualification Procedure for Reinforcing Steel Epoxy Coating Applicators," The Construction Division maintains a list or approved applicators.

Coat reinforcing steel in accordance with Table 3.

Table 3
Epoxy Coating Requirements for Reinforcing Steel

Material	Specification
Bar	ASTM A 775 or A 934
Wire or fabric	ASTM A 884 Class A or B
Mechanical couplers	As shown on the plans
Hardware	As shown on the plans

Use epoxy coating material and coating repair material that complies with DMS-8130, "Epoxy Powder Coating for Reinforcing Steel." Do not patch more than 1/4 in. total length in any foot at the applicator's plant,

Epoxy-coated reinforcement will be sampled and tested in accordance with Tex-739-1.

Maintain identification of all reinforcing throughout the coating and fabrication and until delivery to the project site. Furnish 1 copy of a written certification that the coated reinforcing steel meets the requirements of this Item and 1 copy of the manufacturer's control tests.

C. Mechanical Couplers. When mechanical splices in reinforcing steel bars are shown on the plans, use the following types of coupler:

- sleeve-filler,
- sleeve-threaded,
- sleeve-swaged, or
- sleeve-wedge.

Furnish only couplers that have been produced by a manufacturer that has been prequalified in accordance with DMS-4510, "Mechanical Couplers," Sleeve-wedge type couplers will not be permitted on coated reinforcing, Couplers for use on individual projects must be sampled and tested in accordance with DMS-4510. Furnish couplers only at locations shown on the plans.

440.3. Construction.

A. Bending. Cold-bend the reinforcement accurately to the shapes and dimensions shown on the plans. Fabricate in the shop if possible, Field-fabricate, if permitted, using a method approved by the Engineer. Replace improperly fabricated, damaged, or broken bars at no additional expense to the Department, Repair damaged or broken bars embedded in a previous concrete placement using a method approved by the Engineer.

Unless otherwise shown on the plans, the inside diameter of bar bends, in. terms of the nominal bar diameter (d), must be as shown in Table 4.

Table 4
Minimum Inside Diameter of Bar Bends

Bend	Bar Size Number (in.)	Bar Size Number (mm)	Diameter
Bends of 90° and greater in stirrups, ties, and other secondary bars that enclose another bar in the bend	3, 4, 5	10, 13, 16	4d
	6, 7, 8	19, 22, 25	6d
Bends in main ba[s] and in secondary bars not covered above	3 through 8	10 through 25	6d
	9, 10, 11	29, 32, 36	8d
	14, 18	43, 57	10d

Note: Bar size numbers (in.) are based on the number of eighths of an inch included in the nominal diameter of the bar. Bar size numbers (min) approximate the number of millimeters included in the nominal diameter of the bar.

Where bending No. 14 or No. 18 Grade 60 bars is required, bend-test representative specimens as described for smaller bars in the applicable ASTM specification. Make the required 90° bend around a pin with a diameter of 10 times the nominal diameter of the bar.

B. Tolerances. Fabrication tolerances for bars are shown in Figure 1.

C . Storage Store steel reinforcement above the ground on platforms, skids, or other supports, and protect it from damage and deterioration. Ensure that reinforcement is free from dirt, paint, grease, oil, and other foreign materials when it is placed in the work. Use reinforcement free**.** from defects such as cracks and delaminations. ns. Rust, surface seams, surface irregularities, or mill scale will not be cause for rejection if the minimum cross-sectional area of a hand wire-brushed specimen meets the requirements for the size of steel specified.

D. Splices. Lap-splice, weld-splice, or mechanically splice bars as shown on the plans. Additional splices not shown on the plans will require approval. Splices not shown on the plans will be permitted in slabs 15 in, or less in thickness, columns, walls, and parapets.

- Unless otherwise approved, splices will not be permitted in bars 30 ft. or less in plan length. For bars exceeding 30 ft. in plan length, the distance center-to-center of splices must be at least 30 ft. minus 1 splice length, with no more than 1 individual bar length less than 10 ft. Make lap splices not shown on the plans, but otherwise permitted, in accordance with Table 5. Maintain the specified concrete cover and spacing at splices, and place the lap-spliced bars in contact, securely tied together.

Table 5
Minimum Lap Requirements for Bar Sizes through No. 11

Bar Size Number in.)	Bar Size Number (mm)	Uncoated Lap Length	Coated Lap Length
3	10	1 ft. 4 in.	2ft. 0in.
4	13	1 ft. 9 in.	2 ft. 8 in.
5	16	2 ft. 2in.	3 ft. 3in.
6	19	2 ft. 7 in.	3 ft. 11 in.
7	22	3 ft. 5 in	5 ft. 2 in.
8	25	4 ft. 6in.	6ft.9in.
9	29	5 ft. 8in.	8ft.6in
10	32	7 ft. 3 in.	10 ft. 11 in.
11	36	8 ft. 11in.	13 ft. 5 in.

Note: Bar size numbers (in.) are based on the number of eighths of an inch included in the nominal diameter of the bar. Bar size numbers (mm) approximate the number of millimeters included in the nominal diameter of the bar.

- Do not lap No. 14 or No, 18, bars,
- Lap spiral stool at least 1 turn.
- Splice welded wire fabric using a lap length that includes the overlap of at least 2 in. cross wires plus 2 in. on each sheet or roll. Splices using bars that develop equivalent strength and are lapped in accordance with Table 5 are permitted.

- For box culvert extensions with less than 1 ft. of fill, lap the existing longitudinal bars with the new bars as shown in Table 3. For extensions with more than 1 ft. of fill, lap at least 1 ft. 0 in.
- Ensure that welded splices conform to the requirements of the plans and of Item 448, "Structural Field Welding." Field-prepare ends of reinforcing bars if they will be butt-welded, Delivered bars must be long enough to permit weld preparation,
- Install mechanical coupling devices in accordance with the manufacturer's recommendations at locations shown on the plans. Protect threaded male or female connections, and make sure the threaded connections are clean when making the connection. Do not repair damaged threads.
- Mechanical coupler alternate equivalent strength arrangements, to be accomplished by substituting larger bar sizes or more bars, will be considered if approved in writing before fabrication of the systems.

E. Placing. Unless otherwise shown on the plans, dimensions shown for reinforcement are to the centers of the bars. Place reinforcement as near as possible to the position shown on the plans, In the plane of the steel parallel to the nearest surface of concrete, bars must not vary from plan placement by more than 1/12 of the spacing between bars. In the plane of the steel perpendicular to the nearest surface of concrete, bars must not vary from plan placement by more than ¼ in. Cover of concrete to the nearest surface of steel must be at least 1 in. unless otherwise shown on the plans.

For bridge slabs, the clear cover tolerance for the top mat or reinforcement is -0, + ½ in.

Locate the reinforcement accurately in the forms, and hold it firmly in place before and during concrete placement by means of bar supports that are adequate in strength and number to prevent displacement and to keep the steel at the proper distance from the forms, Support bars by standard bar supports with plastic tips, approved plastic bar supports, or precast mortal' or concrete blocks when supports are in contact with removable or stay-in place forms. Use bright basic bar supports to support reinforcing steel placed in slab overlays on concrete panels or on existing concrete slabs. Bar supports in contact with soil or subgrade must be approved.

For bar supports with plastic tips, the plastic protection must be at least 3/32 in, thick and extend upward on the wire to a point at least 1/2 in. above the formwork.

All accessories such as tie wires, bar chairs, supports, or clips used with epoxy-coated reinforcement must be of steel, fully coated with epoxy or plastic. Plastic supports approved by the Engineer may also be used with epoxy-coated reinforcement.

Cast mortar or concrete blocks to uniform dimensions with adequate bearing area, Provide a suitable tie wire in each block for anchoring to the steel. Cast the blocks to the thickness required in approved molds. The surface placed adjacent to the form most be a true plane, free of surface imperfections. Cure the blocks by covering then with wet burlap or mats for a period of 72 hr. Mortar for blocks should contain approximately 1 part. hydraulic cement to 3 parts sand. Concrete for blocks should contain 850 lb. of hydraulic cement per cubic yard of concrete.

Place individual bar supports in rows at 4-ft, maximum spacing in each direction, Place continuous type bar supports at 4-ft, maximum spacing. Use continuous bar supports with permanent metal deck forms.

The exposure of the ends of longitudinals, stirrups, and spacers used to position the reinforcement in concrete pipe and in precast box culverts or storm drains is not cause for rejection.

Tie reinforcing steel for bridge slabs, top slabs of direct traffic culverts, and top slabs of prestressed box beams at all intersections, except tie only alternate intersections where spacing is loss than 1 ft. in each direction. For reinforcing steel cages for other structural members, tie the steel at enough intersections to provide a rigid cage of steel. Fasten mats of wire fabric securely at the ends and edges. Before concrete placement, clean mortar, mud, dirt, debris, oil, and other foreign material from the reinforcement. Do not place concrete until authorized.

If reinforcement is not adequately supported or tied to resist settlement, reinforcement is floating upward, truss bars are overturning, or movement is detected in any direction during concrete placement, stop placement until corrective measures are taken.

F. Handling, Placement, and Repair of Epoxy-Coated Reinforcing Steel.

1. Handling. Provide systems for handling coated reinforcement with padded contact areas. Pad bundling bands or use suitable banding to prevent damage to the coating. Lift bundles of coated reinforcement with a strongback, spreader bar, multiple supports, or a platform bridge. Transport the bundled reinforcement carefully, and store it on protective cribbing. Do not drop or drag the coated reinforcement.

2. Construction Methods. Do not flame-cut coated reinforcement. Saw or shear-cut only when approved.

Coat cut ends as specified in Section 440.3.F.3, "Repair of Coating."

Do not weld or mechanically couple coated reinforcing steel except where specifically shown *on* the plans. Remove the epoxy coating at least 6 in. beyond the weld limits before welding and 2 in. beyond the limits of the coupler before assembly, After welding or coupling, clean the steel of oil, grease, moisture, dirt, welding contamination (slag or acid residue), and rust to a near-white finish, Check the existing epoxy for damage. Remove any damaged or loose epoxy back to sound epoxy coating.

After cleaning, coat the splice area with epoxy repair material to a thickness of 7 to 17 mils after curing. Apply a second application of repair material to the bar and coupler interface to ensure complete sealing of the joint.

3. **Repair of Coating.** For repair of the coating, use material that complies *with* the requirements of this Item and ASTM D 3963. Make repairs in accordance with procedures recommended by the manufacturer of the epoxy coating powder. For areas to be patched, apply at least the same coating thickness as required for the original coating. Repair all visible damage to the coating.

   Repair sawed and sheared ends, cuts, breaks, and other damage promptly before additional oxidation occurs. Clean areas to be repaired to ensure that they are free from surface contaminants. Make repairs in the shop or in the field as required.

ITEM 462
CONCRETE BOX CULVERTS AND STORM DRAINS

462.1. Description. Furnish, construct, and install concrete box culverts and storm drains.

462.2. Materials.

A. **General.** Furnish materials in accordance with the following:

- Item 420, "Concrete Structures"
- Item 421, "Hydraulic Cement Concrete"
- Item 440, "Reinforcing Steel"
- Item 464, "Reinforced Concrete Pipe."

Provide cast-in-place or precast, formed or machine-made, box culverts and storm drains. For culverts with overlay or a 1- to 2-course surface treatment or if the top slab is the final riding surface, use Class S concrete for top slabs of cast-in-place concrete culverts unless otherwise shown on the plans. Use Class C concrete for the rest of the culvert and for all other cast-in-place boxes. Culverts with fill do not require Class S concrete.

Furnish concrete for machine-made precast boxes in accordance with ASTM C 1433.

When sulfate-resistant concrete is required, do not use Class C fly ash.

B. Fabrication.

1. **Cast-in-Place,** Meet Item 420, "Concrete Structures."
2. **Formed Precast.** Meet Item 424, "Precast Concrete Structures (Fabrication)."
3. **Machine-Made Precast.** Furnish machine-made precast boxes in accordance with ASTM C 1433, Ensure that concrete is placed uniformly in the forms. Compact by mechanical devices to ensure dense concrete. Mix concrete in a central batch plant or other approved batching facility from which the quality and uniformity of the concrete can be ensured. Do not use transit-mixed concrete.

C. **Testing.**

1. **Cast-in-Place.** Provide test specimens that meet Item 421, "Hydraulic Cement Concrete."
2, **Formed Precast.** Produce test specimens in accordance with Tex-704-I.
3. **Machine-Made Precast.** Make test specimens in test cylinders at the same time and in the same manner as the box sections they represent. Make a minimum of 4 test cylinders for each day's production run and each mix design. Cure test cylinders in the same manner and for the same times as the boxes they represent. Test the specimens in accordance with Tex-704-I.
4. **Testing Equipment.** The producer must furnish all equipment required for testing concrete for boxes produced in a precasting plant.

D. Lifting Holes. For precast boxes, provide no more than 4 lifting holes in each section. Lifting holes may be cast, cut into fresh concrete after form removal, or drilled. Provide lifting holes of sufficient size for adequate lifting devices based on the size and weight of the box section. Do not use lifting holes larger than 3 in. in diameter. Do not cut more than 1 longitudinal wire or 2 circumferential wires per layer of reinforcing steel when locating lift holes. Repair spilled areas around lifting holes.

E. Marking. Mark precast boxes with the following:

- name or trademark of the producer;
- date of manufacture;
- box size;
- minimum and maximum fill heights; and
- match marks proper installation, when required, under Section 462.2,F, "Tolerances."

For boxes without lifting holes, mark 1 end of each box section on the inside and outside walls to indicate the top or bottom as it will be installed.

Indent markings into the box section or paint them on each box with waterproof paint.

F. Tolerances. Ensure that precast sections of either type meet the following requirements:

- The inside vertical and horizontal dimensions do not vary from plan requirements by more than 1/2 in. or 1%, whichever is greater.
- The horizontal or vertical plane at each end of the box section does not vary from perpendicular by more than 1/2 in. or 1%, whichever is greater, measured on the inside faces of the section.
- The sides of a section at each end do not vary from being perpendicular to the top and bottom by more than 1/2 in, or 1%, whichever is greater, when measured diagonally between opposite interior corners.

Ensure that wall and slab thicknesses are not less than shown on the plans except for occasional deficiencies not greater than 114 in. or 5%, whichever is greater. If proper jointing is not affected, thicknesses in excess of plan requirements are acceptable.

Deviations from the above tolerances will be acceptable if the sections can be fitted at the plant or job site and the joint opening at any point does not exceed 1 in. Use match marks for proper installation on sections that have been accepted in this manner.

G. Defects and Repair. Fine cracks on the surface of the member that do not extend to the plane of the nearest reinforcement are acceptable unless the cracks are numerous and extensive. Repair cracks that extend into the plane of the reinforcing steel in an approved manner. Excessive damage, honeycomb, or cracking will be subject to structural review. The Engineer may accept boxes with repairs that are sound, properly finished, and cured in conformance with pertinent specifications. When fine cracks on the surface indicate poor curing practices, discontinue further production of precast sections until corrections are made and proper curing is provided.

H. Storage and Shipment. Store precast sections on a level surface, Do not place any load on the sections until design strength is reached and curing is complete. Shipment of sections is permissible when the design strength and curing requirements have been met.

462.3. Construction.

A. Excavation, Shaping, Bedding, and Backfill. Excavate, shape, bed, and backfill in accordance with Item 400, "Excavation and Backfill for Structures," except where jacking, boring, or tunneling methods are shown on the plans or are permitted. Jack, bore, or tunnel in accordance with Item 476, "Jacking, Boring, or Tunneling Pipe or Box." For all box structures where joints consist of materials other than mortar, immediate backfilling is permitted. Take precautions in placing and compacting the backfill to avoid any movement of the boxes or damage to the joints. Remove and replace boxes damaged by the Contractor at no expense to the Department.

B. Placement of Boxes. When precast boxes are used to form multiple barrel structures, place the box sections in conformance with the plans or as directed. Place material to be used between barrels as shown on the plans or as directed. Unless otherwise authorized, start the laying of boxes on the bedding at the outlet end and proceed toward the inlet end with the abutting sections properly matched. Fit, match, and lay the boxes to form a smooth, uniform conduit true to the established lines and grades. For trench installations, lower the box sections into the trench without damaging the box or disturbing the bedding and the sides of the trench. Carefully clean the ends of the box before it is placed, Prevent the earth or bedding material from entering the box as it is laid. Remove and re-lay, without extra compensation, boxes that are not in alignment or that show excessive settlement after laying. Form and place cast-in-place boxes in accordance with Item 420, "Concrete Structures."

B. Jointing. Unless otherwise shown on the plans, use any of the jointing materials in accordance with the jointing requirements specified in Item 464, "Reinforced Concrete Pipe."

C. Connections and Stub Ends. Make connections of boxes to existing boxes, pipes, storm drains, or storm drain appurtenances as shown on the plans. Mortar or concrete the bottom of existing structures if necessary to eliminate any drainage pockets created by the connections, Connect boxes to any required headwalls, wingwalls, safety end treatments or riprap, or other structures as shown on the plans or as directed. Repair any damage to the existing structure resulting from making the connections. Finish stub ends for connections to future work not shown on the plans by installing watertight plugs into the free end of the box.

For precast boxes, fill lifting holes with mortar or concrete and cure. Precast concrete or mortar plugs may be used.

ITEM 464
REINFORCED CONCRETE PIPE

464.1. Description. Furnish and install reinforced concrete pipe, materials for precast concrete pipe culverts, or precast concrete storm drain mains, laterals, stubs, and inlet leads.

464.2. Materials.

A. Fabrication. Provide precast reinforced concrete pipe that conforms to the design shown on the plans and to the following:

- ASTM C 76 or ASTM C 655 unless otherwise shown on the plans for circular pipe, or
- ASTM C 506 for arch pipe, or
- ASTM C 507 for horizontal elliptical pipe.

Provide precast concrete pipe that is machine-made or cast by a process that will provide for uniform placement of the concrete in the form and compaction by mechanical devices that will assure a dense concrete. Mix concrete in a central batch plant or other approved batching facility where the quality and uniformity of the concrete is assured. Do not use transit-mixed concrete for precast concrete pipe. When sulfate-resistant concrete is required, do not use Class C fly ash.

Do not place more than 2 holes for lifting and placing in the top section of precast pipe, Cast, cut, or drill the lifting holes in the wall of the pipe. The maximum hole diameter is 3 in. at the inside surface of the pipe wall and 4 in, at the outside surface. Do not cut more than I longitudinal wire or 2 circumferential wires per layer of reinforcing steel when locating lift holes.

B. Design.

1. General. The class and D-load equivalents are shown in Table I. Furnish arch pipe in accordance with ASTM C 506 and the dimensions shown in Table 2. Furnish horizontal elliptical pipe in accordance with ASTM C 507 and the dimensions shown in Table 3. For arch pipe and horizontal elliptical pipe the minimum height of cover required is 1 ft.

Table 1 Circular Pipe
ASTM C 76 & ASTM C 655

Class	D-Load
I	800
II	1,000
III	1,350
IV	2,000
V	3,000

Table 2 Arch Pipe

Design Size	Equivalent Diameter (in.)	Rise (in.)	Span (in.)
1	18	13-½	22
2	21	15–½	26
3	24	18	28–½
4	60	22-½	36-¼
5	36	26–5/8	43-¾
6	42	31-5/16	51-1/8
7	48	36	58-½
8	54	40	65
9	60	45	73
10	72	54	88

Table 3 Horizontal Elliptical Pipe

Design Size	Equivalent Diameter in.)	Rise (in.)	Span (in.)
1	18	14	23
2	24	19	30
3	27	22	34
4	30	24	38
5	33	27	42
6	36	29	45
7	39	32	49
8	42	34	53
9	48	38	60
10	54	43	68

2. Jacking, Boring, or Tunneling. Design pipe for jacking, boring, or tunneling considering the specific installation conditions such as the soil conditions, installation methods, anticipated deflection angles, and jacking stresses. When requested, provide design notes and drawings signed and sealed by a Texas licensed professional engineer.

C. Physical Test Requirements. Acceptance of the pipe will be determined by the results of the following tests:

- material tests required in ASTM C 76, C 655, C 506, or C 507,
- absorption tests in accordance with ASTM C 497,
- three-edge bearing tests in accordance with ASTM C 497 (Perform 3-edge bearing tests on 1 pipe for each 300 pipes or fraction thereof for each design or shape, size, class, or D-load produced within 30 calendar days. Test for the load to produce a 0.01-in. crack or 15% in excess of the required D-load, whichever is less. Test the pipe to ultimate load if so directed. Tested pipe that satisfies the requirements of Section 464.2.F., "Causes for Rejection," may be used for construction. As an alternate to the 3edge bearing test, concrete pipe 54 in. in diameter and larger may be accepted on the basis of compressive strength of cores cut from the wall of the pipe. The manufacturer must determine the compressive strength of the samples. Obtain, cure, prepare, and test the cores in accordance with ASTM C 497. The manufacturer must plug and seal core holes in the pipe wall after testing.), and
- inspection of the finished pipe to determine its conformance with the required design and its freedom from defects.

D. Marking. Clearly mark the following information on each section of pipe:

- class or D-load of pipe,
- ASTM designation,
- date of manufacture,
- name or trademark of the manufacturer, and
- pipe to be used for jacking and boring.

For pipe with elliptical reinforcement, clearly mark 1 end of each section during the process of manufacture or immediately thereafter. Mark the pipe on the inside and the outside of opposite walls to show the location of the top or bottom of the pipe as it should be installed unless the external shape of the pipe is such that the correct position of the top and bottom is obvious. Mark the pipe section by indenting or painting with waterproof paint.

E. Inspection. Provide facilities and access to allow for inspection regarding the quality of materials, the process of manufacture, and the finished pipe at the pipe manufacturing plant. In addition, provide acc ess for inspection of the finished pipe at the project site before and during installation.

F. Causes for Rejection. Individual sections of pipe may be rejected for any of the following:

- fractures or cracks passing through the shell, with the exception of a single end crack that does not exceed the depth of the joint;
- defects that indicate imperfect proportioning, mixing, and molding;
- surface defects indicating honeycombed or open texture;
- damaged ends where such damage would prevent making a satisfactory joint;
- any continuous crack having a surface width of 0.01 in. or more and extending for a length of 12 in. or more.

G. Repairs. Make repairs if necessary because of occasional imperfections in manufacture or accidental damage during handling. The Engineer may accept pipe with repairs that are sound, properly finished, and cured in conformance with pertinent specifications.

H. Rejections. Allow access for the marking of rejected pipe. Rejected pipe will be plainly marked by the Engineer by painting colored spots over the Department monogram on the inside wall of the pipe and on the top outside wall of the pipe. The painted spots will be no larger than 4 in. in diameter. The rejected pipe will not be defaced in any other manner, Remove the rejected pipe from the project and replace with pipe meeting the requirements of this Item.

I. Jointing Materials. Use any of the materials described herein for the making of joints, unless otherwise shown on the plans. Furnish a manufacturer's certificate of compliance for all jointing materials except mortar.

1. Mortar. Provide mortar for joints that meets the requirements of Section 464.3,C, "Jointing."

2. Cold-Applied, Plastic Asphalt Sewer Joint Compound. Provide a material that consists of natural or processed asphalt base, suitable volatile solvents, and inert filler. The consistency is to be such that the ends of the pipe can be coated with a layer of the compound up to 112 in, thick by means of a trowel. Provide a joint compound that cures to a firm, stiff plastic condition after application. Provide a material of a uniform mixture. If any small separation occurs in the container, stir to a uniform mix before using.

Provide a material that meets the requirements of Table 4 when tested in accordance with Tex-526-C.

Table 4
Cold-Applied, Plastic Asphalt Sewer Joint Compound
Material Requirements

Composition	Analysis
Asphalt base, I00%-% volatiles-% ash, % by weight	28-45
Volatiles, 212°F evaporation, 24 hr., % by weight	10-26
Mineral matter, determined as ash, % by weight	30-55
Consistency, cone penetration, 150 q, 5 sec,, 77°F	150-275

3. Rubber Gaskets. Provide gaskets that conform to ASTM C 361 or C 443. Meet the requirements of ASTM C 443 for design of the joints and permissible variations in dimensions.

4. Pre-Formed Flexible Joint Sealants. Pre-formed flexible joint sealants may be used for sealing joints of tongue-and-groove concrete pipe, Provide flexible joint sealants that meet the requirements of ASTM C 990. Use flexible joint sealants that do not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength. Supply in extruded rope form of suitable cross section, Provide a size of the pre-formed flexible joint sealant in accordance with the manufacturer's recommendations and large enough to property seal the joint. Flexible joint sealants must be protected by a suitable wrapper, and the jointing material must maintain integrity when the wrapper is removed.

464.3. Construction.

A. Excavation, Shaping, Bedding, and Backfill. Excavate, shape, bed, and backfill in accordance with Item 400, "Excavation and Backfill for Structures," except where jacking, boring, or tunneling methods are permitted, Jack, bore, or tunnel the pipe in accordance with Item 476, "Jacking, Boring, or Tunneling Pipe or Box." If joints consist of materials other than mortar, immediate backfilling is permitted. Take special precautions in placing and compacting the backfill to avoid any movement of the pipe or damage to the joints. Unless otherwise shown on the plans or permitted in writing, do not use heavy earth-moving equipment to haul over the structure until a minimum of 4 ft. of permanent or temporary compacted fill has been placed over the structure. Remove and replace pipe damaged by the Contractor at no expense to the Department.

B. Laying Pipe. Unless otherwise authorized, start the laying of pipe on the bedding at the outlet end with the spigot or tongue end pointing downstream, and proceed toward the inlet end with the abutting sections properly matched, true to the established lines and grades. Fit, match, and lay the pipe to form a smooth, uniform conduit, Where bell and-spigot pipe is used, cut cross trenches in the foundation to allow the barrel of the pipe to rest firmly upon the bedding. Do not cut cross trenches more than 2 in, larger than the bell ends of the pipe. Lower sections of pipe into the trench without damaging the pipe or disturbing the bedding and the sides of the trench, Carefully clean the ends of the pipe before the pipe is placed, Prevent the earth or bedding material from entering the pipe as it is laid. When elliptical pipe with circular reinforcing or circular pipe with elliptical reinforcing is used, lay the pipe in the trench so that the markings for the top or bottom are not more than 5° from the vertical plane through the longitudinal axis of the pipe. Remove and re-lay, without extra compensation, pipe that is not in alignment or that shows excessive settlement after laying.

Lay multiple lines of reinforced concrete pipe with the centerlines of the individual barrels parallel, Unless otherwise shown on the plans, use the clear distances between outer surfaces of adjacent pipes shown in Table 5. For arch pipe or horizontal elliptical pipe use the equivalent diameter from Table 2 or Table 3 to determine the clear distance requirement in Table 5.

Table 5
Minimum Clear Distance between Pines

Equivalent Diameter	Min. Clear Distance
18 in.	9 in.
24 in.	11 in.
30 in.	1 ft. 1 in.
36 in.	1 ft. 3 in.
42 in,	1 ft. 5 in.
48 in,	1 ft. 7 in.
54 in.	1 ft. 11 in.
60 to 84 in.	2 ft.

C. Jointing. Make available an appropriate rolling device similar to an automobile mechanic's "creeper" for conveyance through small-size pipe structures.

1. **Joints Sealed with Hydraulic Cement Mortar.** Use mortar consisting of 1 part cement, 2 parts sand, and enough water to make a plastic mix. Clean and wet the pipe ends before making the joint, Plaster the lower half of the bell or groove and the upper half of the tongue or spigot with mortar. After the pipes are tightly jointed, pack mortar into the joint from both inside and outside the pipe. Finish the inside smooth and flush with adjacent joints of pipe. For tongue-and-groove joints, form a bead of semicircular cross section over the joint outside the pipe, extending at least 1 in. on each side of the joint. For bell-and-spigot joints, form the mortar to a 45° fillet between the outer edge of the bell and the spigot. Cure mortar joints by keeping the

joints wet for at least 48 hr. or until the backfill has been completed, whichever comes first. When mortar joints are used, do not place fill or backfill until the jointing material has cured for at least 6 hr. Do not conduct jointing when the atmospheric temperature is at or below 40°F. Protect mortared joints against freezing by backfilling or other approved methods for at least 24 hr.

Driveway culverts do not require morta[r] banding on the outside of the pipe.

With approval, pipes that are large enough for a person to enter may be furnished with the groove between ½ in. and 3/4 in. longer than the tongue. Such pipe may be laid and backfilled without mortar joints. After the backfilling has been completed, clean the space on the interior of the pipe between the end of the tongue and the groove of all foreign material, thoroughly wet and fill with mortar around the entire circumference of the pipe, and finish flush.

2. **Joints Using Cold-Applied, Plastic Asphalt Sewer Joint Compound.** Ensure that both ends of the pipes are clean and dry, Trowel or otherwise place a ½ in.-thick layer of the compound in the groove end of the pipe covering at least 2/3 of the joint face around the entire circumference. Next, shove home the tongue end of the next pipe with enough pressure to make a tight joint. After the joint is made, remove any excess mastic projecting into the pipe, Backfill after the joint has been inspected and approved.

3. **Joints Using Rubber** Gaskets. Make the joint assembly according to the recommendations of the gasket manufacturer. When using rubber gaskets, make joints watertight, Backfill after the joint has been inspected and approved.

4. **Joints Using Pre-Formed Flexible Joint Sealants.** Install pre-formed flexible joint sealants in accordance with the manufacturer's recommendations. Place the joint sealer so that no dirt or other deleterious materials come in contact with the joint sealing material. Pull or push home the pipe with enough force to properly seal the joint. Remove any joint material pushed out into the interior of the pipe that would tend to obstruct the flow. When the atmospheric temperature is below 60°F', store pre-formed flexible joint sealants in an area warmed to above 70°F or artificially warm to this temperature in an approved manner. Apply flexible joint sealants to pipe joints immediately before placing pipe in trench, and then connect pipe to previously laid pipe, Backfill after the joint has been inspected and approved.

D. Connections and Stub Ends. Make connections of concrete pipe to existing pipes, pipe storm drains, or storm drain appurtenances as shown on the plans,

Mortar or concrete the bottom of existing structures if necessary to eliminate any drainage pockets created by the connections. Repair any damage to the existing structure resulting from making the connections.

Unless otherwise shown in the plans, make connections between concrete pipe and corrugated metal pipe with a suitable concrete collar having a minimum thickness of 4 in.

Finish stub ends for connections to future work not shown on the plans by installing watertight plugs into the free end of the pipe.

Fill lift holes with concrete, mortar, or precast concrete plugs after the pipe is in place.

ITEM 465

MANHOLES AND INLETS

465.1. Description. Construct manholes and inlets, complete in place or to the stage detailed, including furnishing and installing frames, grates, rings and covers. Drainage junction boxes are classified as manholes.

465.2. Materials. Furnish materials in accordance with the following:

- Item 420, "Concrete Structures"
- Item 421, "Hydraulic Cement Concrete"
- Item 440, "Reinforcing Steel"
- Item 471, "Frames, Grates, Rings, and Covers"

Precast manholes, inlets, risers, and appurtenances are acceptable unless otherwise shown. Alternate designs for precast items must be acceptable to the Engineer and not deviate from the functional dimensions given. Alternate designs are to be designed and sealed by a licensed professional engineer.

A. **Concrete.** Furnish Class A concrete for cast-in-place manholes and inlets unless otherwise shown on the plans. Furnish Class A concrete or concrete meeting ASTM C 478 for precast manholes and inlets. Air-entrained concrete will not be required in precast concrete members.

B. **Mortar.** Furnish mortar composed of 1 part hydraulic cement and 2 parts clean sand. Hydrated lime or lime putty may be added to the mix to a maximum of 10% by weight of the total dry mix,

C. **Bricks.** Furnish first-quality, sound, perfectly shaped bricks. Provide clay or shale bricks that are homogeneous and thoroughly and uniformly hard-burned and that meet ASTM C 32, Grade MS or MM, Provide concrete bricks meeting ASTM C 55, Type I (Grade S-I). The maximum allowable water absorption of completely dry bricks is 16% by weight when submerged in water for 24 hr.

D. **Concrete Blocks.** Provide concrete blocks that meet ASTM C 139.

E. **Cast Iron or Aluminum.** Provide supports and steps conforming to the shape and dimensions shown on the plans that meet the requirements of ASTM A 48, Class 3513, for gray iron castings or ASTM A 536, Grade 65-45-12, for ductile iron castings. Steps may also be aluminum meeting ASTM B 221, Alloy 6005-T5. Provide steps in accordance with ASTM C 478, Section 16, "Steps and Ladders."

F. Timber. Provide sound timber for temporary covers when used with Stage I construction (see Section 465.3, "Construction") that is a minimum of 3 in. nominal thickness and reasonably free of knots and warps.

G. **Other Materials.** Commercial-type hardware of other materials may be used with prior approval.

465.3. Construction.

A. **General.** All types of manholes and inlets may be built either in 1 stage or in 2 stages, described as Stage I and Stage II. Build manholes and inlets designed to match the final roadway surface in stages. Construct Stage II after the pavement structure is substantially complete unless otherwise approved by the Engineer. Construct the Stage I portion of manholes and inlets as shown on the plans or as specified in this Item. Furnish and install a temporary cover as approved by the Engineer.

For Stage I construction of cast iron or steel inlet units, furnish and install the sewer pipe and a temporary plug for the exposed end of the sewer pipe from the storm sewer to a point below the top of curb indicated on the plans.

For Stage II, construct the remaining wall height and top of manhole or inlet and furnish and install any frames, grates, rings and covers, manhole steps, curb beams, or collecting basins required.
Construct precast manholes and inlets in accordance with Item 420, "Concrete Structures," or ASTM C 478. Construct cast-in-place manholes and inlets in accordance with Item 420, Forms will be required for all concrete walls. Multi-project fabrication plants (as defined in Item 424, "Precast Concrete Structures (Fabrication)") that produce manholes and inlets will be approved by the Construction Division in accordance with DMS-7340, "Qualification Procedure for Multi-Project Fabrication Plants of Precast Concrete Manholes and Inlets." The Construction Division maintains a list of approved multiproject plants. Outside wall forms for cast-in-place concrete may be omitted with the approval of the Engineer if the surrounding material can be trimmed to a smooth vertical face. The outside form for concrete bases supporting brick walls may be omitted. Cast steps into the concrete walls when the concrete is placed, or drill and grout steps in place after concrete placement, Mortar steps into joints for brick walls. Use a full bed of mortar for brick work so the brick will thoroughly bond to the mortar. Construct full mortar joints no more than 112 in, wide for brick walls. Furnish a header course or bond course (laid perpendicular to the preceding courses) every fifth course of brick.

B. **Manholes and Inlets for Precast Concrete Pipe Sewers.** Construct manholes and inlets for precast concrete pipe sewers as soon as is practicable after sewer lines into or through the manhole or inlet locations are completed. Neatly cut all sewers at the inside face of the walls of the manhole or inlet and point up with mortar.

C. **Manholes and Inlets for Monolithic Pipe Sewers.** Construct bases for manholes and inlets on monolithic pipe sewers either monolithically with the sewer or after the sewer is constructed.

D. **Manholes for Box Sewers.** Cast bases for manholes for box sewers as an integral part of the sewer. Construct manholes before backfilling, or cover the manhole opening temporarily and backfill the sewer as a whole.

E. **Inverts.** Shape and route floor inverts passing out or through the manhole or inlet as shown on the plans. Shape by adding and shaping mortar or concrete after the base is cast or by placing the required additional material with the base.

F. **Finishing Complete Manholes and Inlets.** Complete manholes and inlets in accordance with the plans. Backfill to original ground elevation in accordance with Item 400, "Excavation and Backfill for Structures."

G. **Finishing Stage I Construction.** Complete Stage I construction by constructing the walls to the elevations shown on the plans and backfilling to required elevations in accordance with Item 400, "Excavation and Backfill for Structures."

H. **Stage** II **Construction.** Construct subgrade and base course or concrete pavement construction over Stage I manhole or inlet construction, unless otherwise approved by the Engineer. Excavate to expose the top of Stage I construction and complete the manhole or inlet in accordance with the plans and these Specifications, including backfill and cleaning of all debris from the bottom of the manhole or inlet.

I. **Inlet Units.** Install cast iron or steel inlet units in conjunction with the construction of concrete curb and gutter. Set the inlet units securely in position before placing concrete for curb and gutter. Form openings for the inlets and recesses in curb and gutter as shown on the plans. Place and thoroughly consolidate concrete for curb and gutter adjacent to inlets and around the inlet castings and formed openings and recesses without displacing the inlet units.

ITEM 466

HEADWALLS AND WINGWALLS

466.1. Description. Furnish, construct, and install concrete headwalls and wingwalls for drainage structures and underpasses.

466.2. Materials.

A. General. Furnish materials in accordance with the following:

- Item 420, "Concrete Structures"
- Item 421, "Hydraulic Cement Concrete"
- Item 440, "Reinforcing Steel."

Unless otherwise shown on the plans, use Class C concrete for cast-in-place and precast concrete units. Furnish cast-in-place or precast headwalls and wingwalls unless otherwise shown on the plans.

B. Fabrication.

1. General. Fabricate cast-in-place concrete units and precast units in accordance with Item 420, "Concrete Structures." For headwalls and wingwalls use the following definitions:

- "Headwalls" refers to all walls, including wings, at the ends of single-barrel and multiple-barrel pipe culvert structures.
- "Wingwalls" refers to all walls at the ends of single-barrel or multiple-barrel box culvert structures.

2. Lifting Holes. For precast units, provide no more than 4 lifting holes in each section. Lifting holes may be cast, cut into fresh concrete after form removal, or drilled. Provide lifting holes large enough for adequate lifting devices based on the size and weight of the section. The maximum hole diameter is 3 in. at the inside surface of the wall and 4 in. at the outside surface, Do not cut more than I longitudinal wire or 2 circumferential wires per layer of reinforcing steel when locating lift holes. Repair spalled areas around lifting holes.

3. Marking. Before shipment from the casting or fabrication yard, clearly mark the following on each precast unit:

- the date of manufacture,
- the name or trademark of the manufacturer, and
- the type and size designation.

4. **Storage and Shipment.** Store precast units on a level surface, Do not place any loads on precast concrete units until design strength is reached. Do not ship units until design strength requirements have been met.
5. **Causes for Rejection.** Precast units may be rejected for not meeting any one of the specification requirements. Individual units may also be rejected for fractures or cracks passing through the wall or surface defects indicating honeycombed or open texture surfaces. Remove rejected units from the project, and replace them with acceptable units meeting the requirements of this Item.

6. **Defects and Repairs.** Occasional imperfections in manufacture or accidental damage sustained during handling may be repaired. The repaired units will be acceptable if they conform to the requirements of this Item and the repairs are sound, properly finished, and cured in conformance with pertinent specifications.

466.3. Construction.

A. **General.** Remove portions of existing structures in accordance with Item 430.3, "Construction." Drill, dowel, and grout in accordance with Item 420, "Concrete Structures."

B. **Excavation, Shaping, Bedding, and Backfill.** Excavate, shape, bed, and backfill in accordance with Item 400, "Excavation and Backfill for Structures." Take special precautions in placing and compacting the backfill to avoid any movement or damage to the units. Bed precast units on foundations of firm and stable material accurately shaped to conform to the bases of the units.

C. **Placement of Precast Units.** 'Provide adequate means to lift and place the precast units. Fill lifting holes with mortar or concrete and cure. Precast concrete or mortar plugs may be used.

D. **Connections.** Make connections to new or existing structures in accordance with the details shown on the plans, Furnish jointing material in accordance with Item 464, "Reinforced Concrete Pipe," or as shown on the plans.

When removing existing headwalls, also remove a length of the existing pipe from the headwall to the joint as shown on the plans or as approved. Re-lay the removed pipe if approved, or furnish and lay a length of new pipe.

ITEM 471

FRAMES, GRATES, RINGS, AND COVERS

471.1. Description. Furnish and install frames, grates, rings and covers for inlets, manholes, and other structures.

471.2. Materials.

A. **Welded Steel Grates and Frames.** Provide welded steel grates and frames as an assembly conforming to the member size, dimensions, and details shown on the plans. Fabricate these assemblies in accordance with Item 441, "Steel Structures." Use steel that meets ASTM A 36 or equal,

B. **Frame, Grate, Ring, and Cover Castings.** Provide clean castings conforming to the shape and dimensions shown on the plans. Ensure that the castings are free from sand and blow holes or other defects and that surfaces of the castings are reasonably smooth, Remove runners, risers, fins, and other cast-on pieces from the castings, and grind these areas smooth. Cast or machine the bearing surfaces between manhole rings and covers and between grates and frames with such precision that uniform bearing is provided throughout the perimeter area of contact. Matchmark pairs of machined castings for proper identification at installation.

   Provide steel castings conforming to ASTM A 27. Furnish Grade 70-36 unless otherwise specified. Provide gray iron castings conforming to ASTM A 48, Class 35B. Provide ductile iron castings conforming to ASTM A 536. Use Grade 65-45-12 unless otherwise specified. Frame, grate, ring, and cover castings must meet the proof-load testing requirements of AASHTO M 306. Use commercial type frames, rings, risers or appurtenances only with prior approval of the Engineer,

C. **Documentation.** Furnish mill test reports or manufacturer's certification to the Engineer for each lot or shipment of steel and iron materials. For castings, also furnish a manufacturer's certification stating that the casting meets the proof-load testing requirements of AASHTO M 306.

471.3. **Construction.** Construct and install frames, grates, rings, and covers in accordance with the details shown on the plans. Weld in accordance with Item 448, "Structural Field Welding." Tack-weld grates and covers to the frame or ring when directed by the Engineer,

Galvanize steel castings and welded steel grates and frames in accordance with Item 445, "Galvanizing." Galvanizing is not required for iron castings unless used in conjunction with structural steel shapes or shown on the plans.

Provide galvanized bolts and nuts in accordance with Item 445, "Galvanizing."

ITEM 473

LAYING CULVERT AND STORM DRAIN PIPE

473.1. Description. Install furnished culvert and storm drain pipe.

473.2. Materials. Pipe furnished may be new or salvaged or a combination of both. Bituminous coating must meet the requirements of Section 460.2.B, "Protective Coating."

473.3. Construction. Obtain and haul pipe from designated locations. Excavate, bed, and backfill in accordance with Item 400, "Excavation and Backfill for Structures." Install concrete pipe in accordance with Item 464, "Reinforced Concrete Pipe," Install corrugated metal pipe in accordance with Item 460, "Corrugated Metal Pipe." Make connections to existing structures as shown on the plans and in conformance to the requirements for connections in the pertinent pipe specifications or as approved. Connect reinforced concrete pipe to corrugated metal pipe with a suitable concrete collar having a minimum thickness of 4 in. or as shown on the plans. Use a coating of bituminous material to insulate portions of aluminum pipe that are to be in contact with metal other than aluminum, Extend the coating a 1 ft, minimum beyond area of contact. Replace Contractor-damaged items designated for reuse with new material, or restore to previous condition as approved.

ITEM 479

ADJUSTING MANHOLES AND INLETS

479.1. Description. Adjust or cap existing manholes or inlets. Drainage junction boxes will be classified as manholes.

479.2. Materials. Reuse removed manhole and inlet rings, plates, grates, covers, and brick if they are in good condition as determined by the Engineer. Provide additional materials in accordance with Item 465, "Manholes and Inlets," at no cost to the Department. Single- or multiple piece prefabricated metal extension rings may be used for the adjustment of manholes as approved. Provide concrete that meets Item 421, "Hydraulic Cement Concrete."

479.3. Construction. Perform all work in accordance with Item 465, "Manholes and Inlets," Excavate and backfill in accordance with Item 400, "Excavation and Backfill for Structures." Carefully remove manhole and inlet rings, covers, plates, and grates to be reused. Clean mortar and grease from the contact areas of all reused items. Dispose of unused removed material as directed. Use construction methods described in Sections 479.3.A, "Lowering the Top of a Manhole or Inlet;" and 479.3.B, "Raising the Top of a Manhole or Inlet," unless otherwise shown on the plans.

A. **Lowering the Top of** a **Manhole or Inlet.** Remove a sufficient depth of brick courses or concrete to permit reconstruction on a batter not exceeding 1 in. horizontal to 2 in. vertical. Where brickwork is present, clean the mortar from the top course of brick, Rebuild the manhole or inlet to the original top dimensions or to the dimensions shown in the plans. Install the manhole or inlet ring and the cover, plate, or grate to conform to the proposed new surface contour.

B. **Raising the Top of** a **Manhole or Inlet.** Clean the top surface of brick or concrete. Construct to the proper new elevation using new brick, brick salvaged from other manholes or inlets, prefabricated metal extension rings, concrete rings, or Class A concrete, Install the manhole or inlet ring and the cover, plate, or grate to conform to the proposed new surface contour. Install prefabricated extension rings in accordance with manufacturer's instructions.

C. **Capping an Inlet or Manhole.** Remove the inlet or manhole to a minimum of 1 ft. below subgrade elevation or as indicated on the plans. Cap as shown on the plans.

ITEM 502

BARRICADES, SIGNS, AND TRAFFIC HANDLING

502.1. Description. Provide, install, move, replace, maintain, clean, and remove upon completion of work all barricades, signs, cones, lights, and other traffic control devices used for traffic handling as indicated on the plans and as directed.

502.2. Construction. Provide traffic control devices that conform to details shown on the plans, the TMUTCD, and the Compliant Work Zone Traffic Control Device List (CWZTCDL) maintained by the Traffic Operations Division.

A. **Implementation.** Before beginning work, designate in writing a Contractor's Responsible Person (CRP) to be the representative of the Contractor who is responsible for taking or directing corrective measures of installation and maintenance deficiencies as soon as possible. The CRP must be accessible by phone and able to respond to emergencies 24 hours per day.

Follow the traffic control plan (TCP) and install traffic control devices as shown on the plans and as directed. Install traffic control devices straight and plumb. Do not make changes to the location of any device or implement any other changes to the TCP without the approval of the Engineer. Minor adjustments to meet field constructability and visibility are allowed.

Submit Contractor-proposed TCP changes, signed and sealed by a licensed professional engineer, to the Engineer for approval. The Engineer may develop, sign, and seal Contractor-proposed changes. Changes must conform to guidelines established in the TMUTCD using approved products from the CWZTCDL. Maintain traffic control devices by taking corrective action as soon as possible. Corrective action includes but is not limited to cleaning, replacing, straightening, covering, or removing devices, Maintain the devices such that they are properly positioned, spaced, and legible, and that retroreflective cha[r]acteristics meet requirements during darkness and rain.

B. **Flaggers.** Provide a Contractor representative who has been certified as a flagging instructor through courses offered by the Texas Engineering Extension Service, the American Traffic Safety Services Association, the National Safety Council, or other approved organizations. Provide the certificate indicating course completion when requested. This representative is responsible for training and assuring that all flaggers are qualified to perform flagging duties. A qualified flagger must be independently certified by one of the organizations listed above or trained by the Contractor's certified flagging instructor. Provide the Engineer with a current list of qualified flaggers before beginning flagging activities. Use only flaggers on the qualified list.

Flaggers must be courteous and able to effectively communicate with the public. When directing traffic, flaggers must use standard attire, flags, signs, and signals and follow the flagging procedures set forth in the TMUTCD.

C. **Removal.** Upon completion of work, remove all barricades, signs, cones, lights, and other traffic control devices used for work-zone traffic handling, unless otherwise shown on the plans.

ITEM 506
TEMPORARY EROSION, SEDIMENTATION, AND ENVIRONMENTAL CONTROLS

506.1. Description. Install, maintain, and remove erosion, sedimentation, and environmental control devices. Remove accumulated sediment and debris.

506.2. Materials.

A. Rock Filter Dams.

1. Aggregate. Furnish aggregate with hardness, durability, cleanliness, and resistance to crumbling, flaking, and eroding acceptable to the Engineer. Provide the following:

- **Types 1, 2, and 4 Rock Filter Dams.** Use 3 to 6 in. aggregate.
- **Type 3 Rock Filler Dams.** Use 4 to 8 in. aggregate.

2. Wire. Provide minimum 20 gauge galvanized wire for the steel wire mesh and tie wires for Types 2 and 3 rock filter dams. Type 4 dams require:

- a double-twisted, hexagonal weave with a nominal mesh opening of 2-1/2 in. x 3-114 in.;
- minimum 0.0866 steel wire for netting;
- minimum 0.1063 in. steel wire for selvages and corners; and minimum 0,0866 in. for binding or tie wire.

3. Sandbag Material. Furnish sandbags meeting Section 506.2.1, "Sandbags," except that any gradation of aggregate may be used to fill the sandbags.

B. Temporary Pipe Slope Drains. Provide corrugated metal pipe, polyvinyl chloride (PVC) pipe, flexible tubing, watertight connection bands, grommet materials, prefabricated fittings, and flared entrance sections that conform to the plans, Recycled and other materials meeting these requirements are allowed if approved.

Furnish concrete in accordance with Item 432, "Riprap."

C. Baled Hay. Provide hay bales weighing at least 50 lb., composed entirely of vegetable matter, measuring 30 in. or longer, and bound with wire, nylon, or polypropylene string.

D. Temporary Paved Flumes, Furnish asphalt concrete, hydraulic cement concrete, or other comparable non-erodible material that conforms to the plans. Provide rook or rubble with a minimum diameter of 6 in. and a maximum volume of ½ cu. ft. for the construction of energy dissipaters.

E. Construction Exits. Provide materials that meet the details shown on the plans and this Section.

1. Rock Construction Exit. Provide crushed aggregate for long and short-term construction exits. Furnish aggregates that are clean, hard, durable, and free from adherent coatings such as salt, alkali, dirt, clay, loam, shale, soft, or flaky materials and organic and injurious matter. Use 4- to 8-in. aggregate for Type 1 and 2- to 4in. aggregate for Type 3.

2. Timber Construction Exit. Furnish No. 2 quality or better railroad ties and timbers for long-term construction exits, free of large and loose knots and treated to control rot, Fasten timbers with nuts and bolts or lag bolts, of at least 1/2 in. diameter, unless otherwise shown on the plans or allowed. For short-term exits, provide plywood or pressed wafer board at least 1/2 in. thick.

3. Foundation Course. Provide a foundation course consisting of flexible base, bituminous concrete, hydraulic cement concrete, or other materials as shown on the plans or directed.

F. Embankment for Erosion Control. Provide rock, loam, clay, topsoil, or other earth materials that will form a stable embankment to meet the intended use.

G. Pipe. Provide pipe outlet material in accordance with Item 556, "Pipe Underdrains," and details shown on the plans.

H. Construction Perimeter Fence.

1. Posts. Provide essentially straight wood or steel posts that are at least 60 in. long. Furnish soft wood posts with a minimum diameter of 3 in. or use 2 x 4 boards, Furnish hardwood posts with a minimum cross-section of 1-1/2 x 1-1/5 in. Furnish T- or L-shaped steel posts with a minimum weight of 1.3 lb. per foot.

2. Fence. Provide orange construction fencing as approved by the Engineer.

3. Fence Wire. Provide 12-½ gauge or larger galvanized smooth or twisted wire. Provide l6 gauge or larger tie wire.

4. Flagging. Provide brightly-colored flagging that is fade-resistant and at least 3/4 in. wide to provide maximum visibility both day and night.

5. Staples. Provide staples with a crown at least 1/2 in. wide and legs at least 1/2 in. long.

6. Used Materials. Previously used materials meeting the applicable requirements may be used if accepted by the Engineer.

I. Sandbags. Provide sandbag material of polypropylene, polyethylene, or polyamide woven fabric with a minimum unit weight of 4 oz. per square yard, a Mullen burst-strength exceeding 300 psi, and an ultraviolet stability exceeding 70%.

Use natural coarse sand or manufactured sand meeting the gradation given in Table 1 to fill sandbags. Filled sandbags must be 24 to 30 in. long, 16 to 18 in. wide, and 6 to 8 in. thick.

Table 1
Sand Gradation

Sieve #	**Maximum Retained (% by Weight)**
4	3%
100	80%
200	95%

K. Temporary Sediment Control Fence. Provide a net-reinforced fence using woven geo-textile fabric. Logos visible to the traveling public will not be allowed.

1. Fabric. Provide fabric materials in accordance with DMS-6230, "Temporary Sediment Control Fence Fabric."

2. Posts. Provide essentially straight wood or steel posts with a minimum length of 48 in., unless otherwise shown on the plans. Soft wood posts must be at least 3 in. in diameter or nominal 2 x 4 in. Hardwood posts must have a minimum cross-section of 1-½ x 1-½ in. T- or L-shaped steel posts must have a minimum weight of 1.3 lb. per foot.

3. Net Reinforcement. Provide net reinforcement of at least 12-½ gauge galvanized welded wire mesh, with a maximum opening size of 2 x 4 in., at least 24 in. wide, unless otherwise shown on the plans.

4. Staples. Provide staples with a crown at least 3/4 in. wide and legs ½ in. long.

5. Used Materials. Use recycled material meeting the applicable requirements if accepted by the Engineer.

506.3. Equipment. Provide a backhoe, front end loader, blade, scraper, bulldozer, or other equipment as required when "Earthwork for Erosion Control" is specified on the plans as a bid item.

506.4. Construction.

A. Contractor Responsibilities. Implement the Department's Storm Water Pollution Prevention Plan (SWP3) for the project site in accordance with the specific or general storm water permit requirements. Develop and implement an SWP3 for project-specific material supply plants within and outside of the Department's right of way in accordance with the specific or general storm water permit requirements. Prevent water pollution from storm water associated with construction activity from entering any surface water or private property on or adjacent to the project site.

B. General.

1. Phasing. Implement control measures in the area to be disturbed before beginning construction, or as directed. Limit the disturbance to the area shown on the plans or as directed. If, in the opinion of the Engineer, the Contractor cannot control soil erosion and sedimentation resulting from construction operations, the Engineer will limit the disturbed area to that which the Contractor is able to control. Minimize disturbance to vegetation.

2. Maintenance. Immediately correct ineffective control measures. Implement additional controls as directed, Remove excavated material within the time requirements specified in the applicable storm water permit.

3. Stabilization. Stabilize disturbed areas where construction activities will be temporarily stopped in accordance with the applicable storm water permit, Establish a uniform vegetative cover. The project will not be accepted until a 70% density of existing adjacent undisturbed areas is obtained, unless otherwise shown on the plans, When shown on the plans, the Engineer may accept the project when adequate controls are in place that will control erosion, sedimentation, and water pollution until sufficient vegetative cover can be established.

4. Finished Work. Upon acceptance of vegetative cover, remove and dispose of all temporary control measures, temporary embankments, bridges, matting, falsework, piling, debris, or other obstructions placed during construction that are not a part of the finished work, or as directed.

5. Restricted Activities. Do not locate disposal areas, stockpiles, or haul roads in any wetland, water body, or streambed.

Do not install temporary construction crossings in or across any water body without the prior approval of the appropriate resource agency and the Engineer. Restrict construction operations in any water body to the necessary areas as shown on the plans or applicable permit, or as directed. Use temporary bridges, timber mats, or other structurally sound and non-eroding material for stream crossings.

Provide protected storage area for paints, chemicals, solvents, and fertilizers at an approved location. Keep paints, chemicals, solvents, and fertilizers off bare ground and provide shelter for stored chemicals.

C. Installation, Maintenance, and Removal Work. Perform work in accordance with the specific or general storm water permit. Install and maintain the integrity of temporary erosion and sedimentation control devices to accumulate silt and debris until earthwork construction and permanent erosion control features are in place or the disturbed area has been adequately stabilized as determined by the Engineer. If a device ceases to function as intended, repair or replace the device or portions thereof as necessary. Remove sediment, debris, and litter. When approved, sediments may be disposed of within embankments, or in the right of way in areas where the material will not contribute to further siltation. Dispose of removed material in accordance with federal, state, and local regulations.

Remove devices upon approval or when directed. Upon removal, finish-grade and dress the area. Stabilize disturbed areas in accordance with the permit, and as shown on the plans or directed. The Contractor retains ownership of stockpiled material and must remove it from the project when new installations or replacements are no longer required.

1. Rock Filter Darns for Erosion Control. Remove trees, brush, stumps, and other objectionable material that may interfere with the construction of rock filter dams. Place sandbags as a foundation when required or at the Contractor's option.

For Types 1, 2, 3, and 5, place the aggregate to the lines, height, and slopes specified, without undue voids. For Types 2 and 3, place the aggregate on the mesh and then fold the mesh at the upstream side over the aggregate and secure it to itself on the downstream side with wire ties, or hog rings, or as directed. Place rock filter dams perpendicular to the flow of the stream or channel unless otherwise directed. Construct filter dams according to the following criteria, unless otherwise shown on the plans:

a. Type 1 (Non-reinforced).

(1) **Height.** At least 18 in. measured vertically from existing ground to top of filter dam.
(2) **Top Width.** At least 2 ft.
(3) **Slopes.** At most 2:1.

b. Type 2 **(Reinforced).**

(1) **Height.** At least 18 in. measured vertically from existing ground to top of filter dam,
(2) **Top Width.** At least 2 ft.
(3) **Slopes.** At most 2:1.
(4)

c. Type 3 (Reinforced).

(1) **Height.** At least 36 in. measured vertically from existing ground to top of filter dam.
(2) **Top** Width. At least 2 ft,
(3) Slopes. At most 2:1.

d. Type 4 (Sack Gabions). Unfold sack gabions and smooth out kinks and bends. For vertical filling, connect the sides by lacing in a single loop-double loop pattern on 4- to 5-in, spacing, At one end, pull the end lacing rod until tight, wrap around the end, and twist 4 times, At the filling end, fill with stone, pull the rod tight, cut the wire with approximately 6 in. remaining, and twist wires 4 times.

For horizontal filling, place sack flat in a filling trough, fill with stone, and connect sides and secure ends as described above.

Lift and place without damaging the gabion. Shape sack gabions to existing contours.

e. Type 5. Provide rock filter dams as shown on the plans.

2. Temporary Pipe Slope Drains. Install pipe with a slope as shown on the plans or as directed. Construct embankment for the drainage system in 8-in, lifts to the required elevations. Hand-tamp the soil around and under the entrance section to the top of the embankment as shown on the plans or as directed, Form the top of the embankment or earth dike *over* the pipe slope drain at least 1 ft. higher than the top of the inlet pipe at all points, Secure the pipe with hold-downs or hold-down grommets spaced a maximum of 10 ft. on center. Construct the energy dissipators or sediment traps as shown on the plans or as directed. Construct the sediment trap using concrete or rubble riprap in accordance with Item 432, "Riprap," when designated on the plans.

3. Baled Hay for Erosion and Sedimentation Control. Install hay bales at locations shown on the plans by embedding in the soil at least 4 in. and, where possible, approximately 112 the height of the bale, or as directed. Fill gaps between bales with hay.

4. Temporary Paved Flumes. Construct paved flumes as shown on the plans or as directed. Provide excavation and embankment (including compaction of the subgrade) of material to the dimensions shown on the plans, unless otherwise indicated. Install a rock or rubble riprap energy dissipater, constructed from the materials specified above to a minimum depth of 9 in. at the flume outlet to the limits shown on the plans or as directed.

5. Construction Exits. When tracking conditions exist, prevent traffic from crossing or exiting the construction site or moving directly onto a public roadway, alley, sidewalk, parking area, or other right of way areas other than at the location of construction exits. Construct exits for either long or short-term use.

a, Long-Term. Place the exit over a foundation course, if necessary. Grade the foundation course or compacted subgrade to direct runoff from the construction exits to a sediment trap as shown on the plans or as directed. Construct exits with a width of at least 14 ft. for one-way and 20 ft. for two-way traffic for the full width of the exit, or as directed.

(1) Type 1. Construct to a depth of at least 8 in. using crushed aggregate as shown on the plans or as directed.

(2) Type 2. Construct using railroad ties and timbers as shown on the plans or as directed.

b. Short-Term.

(1) **Type** 3. Construct using crushed aggregate, plywood, or wafer board. This type of exit may be used for daily operations where long-term exits are not practical.

(2) **Type** 4. Construct as shown on the plans or as directed.

6. Earthwork for Erosion Control. Perform excavation and embankment operations to minimize erosion and to remove collected sediments from other erosion control devices.

a. Excavation and Embankment for Erosion Control Features. Place earth dikes, swales, or combinations of both along the low crown of daily lift placement, or as directed, to prevent runoff spillover. Place swales and dikes at other locations as shown on the plans or as directed to prevent runoff spillover or to divert runoff. Construct cuts with the low end blocked with undisturbed earth to prevent erosion of hillsides. Construct sediment traps at drainage structures in conjunction with other erosion control measures as shown on the plans or as directed.

Where required, create a sediment basin providing 3,600 cu. ft. of storage per acre drained, or equivalent control measures for drainage locations that serve an area with 10 or more disturbed acres at one time, not including offsite areas.

b. Excavation of Sediment and Debris. Remove sediment and debris when accumulation affects the performance of the devices, after a rain, and when directed.

7. Construction Perimeter Fence. Construct, align, and locate fencing as shown on the plans or as directed.

a. **Installation of Posts.** Embed posts 18 in. deep or adequately anchor in rock, with a spacing of 8 to 10 it.
b. **Wire Attachment.** Attach the top wire to the posts at least 3 ft. from the ground. Attach the lower wire midway between the ground and the top wire.
c. **Flag Attachment.** Attach flagging to both wire strands midway between each post. Use flagging at least 18 in. long. Tie flagging to the wire using a square knot.

8. Sandbags for Erosion Control. Construct a berm or dam of sandbags that will intercept sediment-laden storm water runoff from disturbed areas, create a retention pond, detain sediment, and release water in sheet flow. Fill each bag with sand so that at least the top 6 in. of the bag is unfilled to allow for proper tying of the open end. Place the sandbags with their tied ends in the same direction. Offset subsequent rows of sandbags 112 the length of the preceding row. Place a single layer of sandbags downstream as a secondary debris trap. Place additional sandbags as necessary or as directed for supplementary support to berms or dams of sandbags or earth.

9. Temporary Sediment-Control Fence. Provide temporary sediment-control fence near the downstream perimeter of a disturbed area to intercept sediment from sheet flow. Incorporate the fence into erosion-control measures used to control sediment in areas of higher flow. Install the fence as shown on the plans, as specified in this Section, or as directed.

a. **Installation of Posts.** Embed posts at least 18 in. deep, or adequately anchor, if in rock, with a spacing of 6 to 8 ft. and install on a slight angle toward the run-off source.

b. **Fabric Anchoring.** Dig trenches along the uphill side of the fence to anchor 6 to 8 in. of fabric. Provide a minimum trench cross-section of 6 x 6 in. Place the fabric against the side of the trench and align approximately 2 in of fabric along the bottom in the upstream direction. Backfill the trench, then hand-tamp.

c. **Fabric and Net Reinforcement Attachment.** Unless otherwise shown under the plans, attach the reinforcement to wooden posts with staples, or to steel posts with T -clips, in at least 4 places equally spaced. Sewn vertical pockets may be used to attached reinforcement to end posts. Fasten the fabric to the top strand of reinforcement by hog rings or cord every 15 in. or less.

d. **Fabric and Net Splices.** Locate splices at a fence post with a minimum lap of 6 in. attached in at least 6 places equally spaced, unless otherwise shown under the plans. Do not locate splices in concentrated flow areas. Requirements for installation of used temporary sediment control fence include the following:

- fabric with minimal or no visible signs of biodegradation (weak fibers),
- fabric without excessive patching (more than l patch every 15 to 20 ft.),
- posts without bends, and
- backing without holes.

ITEM 529
CONCRETE CURB, GUTTER, AND COMBINED CURB AND GUTTER

529.1. Description. Construct hydraulic cement concrete curb, gutter, and combined curb and gutter.

529.2. Materials. Furnish materials conforming to:

- Item 360, "Concrete Pavement"
- Item 420, "Concrete Structures"
- Item 421, "Hydraulic Cement Concrete"
- Item 440, "Reinforcing Steel"

Use Class A concrete or material specified in the plans. Use Grade 8 coarse aggregate for extruded Class A concrete. Use other grades if approved by the Engineer.

529.3. Construction. Provide finished work with a well-compacted mass and a surface free from voids and honeycomb, in the required shape, line, and grade. Round exposed edges with an edging tool of the radius shown on the plans. Mix, place, and cure concrete in accordance with Item 420, "Concrete Structures." Construct joints at locations shown on the plans. Cure for at least 72 hr.
Furnish and place reinforcing steel in accordance with Item 440, "Reinforcing Steel."

Set and maintain a guideline that conforms to alignment data shown on the plans, with an outline that conforms to the details shown on the plans.

A. **Conventionally Formed Concrete.** Shape and compact subgrade, foundation, or pavement surface to the line, grade, and cross section shown on the plans. Lightly sprinkle subgrade or foundation material immediately before concrete placement.

Pour concrete into forms, and strike off with a template 114 to 318 in. less than the dimensions of the finished curb unless otherwise approved, After initial set, plaster surface with mortar consisting of 1 part hydraulic cement and 2 parts fine aggregate. Brush exposed surfaces to a uniform texture.

Place curbs, gutters, and combined curb and gutters in 50-ft. maximum sections unless otherwise approved.

B. **Extruded or Slipformed Concrete.** Hand-tamp and sprinkle subgrade or foundation material before concrete placement. Provide clean surfaces for concrete placement. If required, coat cleaned surfaces with approved adhesive or coating at the rate of application shown on the plans or as directed. Place concrete with approved self-propelled equipment.

The forming tube of the extrusion machine or the form of the slip form machine must be easily adjustable vertically during the forward motion of the machine to provide variable heights necessary to conform to the established grade line.

Attach a pointer or gauge to the machine so that a continual comparison can be made between the extruded or slip form work and the grade guideline. Other methods may be used when approved.
Finish surfaces immediately after extrusion or slip forming.

ITEM 530

INTERSECTIONS, DRIVEWAYS, AND TURNOUTS

530.1. Description. Construct and pave intersections, driveways, and turnouts. Pave existing intersections, driveways, and turnouts.

Intersections are considered to be areas off the travel lanes and shoulders of the Contract highway on the intersecting highway on the state system. The intersecting on-system highway work will be paid for under this Item only when shown on the plans.

Driveways are defined as private (residential or commercial) and public (county road and city street) access areas off the travel lanes and shoulders.

Turnouts include but are not limited to mailbox and litter barrel widenings.

530.2. Materials. Furnish materials that meet the following:

- Item 247, "Flexible Base"
- Item 260, "Lime Treatment (Road Mixed)"
  Item 263, "Lime Treatment (Plant Mixed)"
- Item 275, "Cement Treatment (Road Mixed)"
- Item 276, "Cement Treatment (Plant Mixed)"
- Item 292, "Asphalt Treatment (Plant Mix)"
- Item 316, "Surface Treatments"
- Item 330, "Limestone Rock Asphalt Pavement"
- Item 334, "Hot Mix-Cold Laid Asphalt Concrete Pavement"
- Item 340, "Dense-Graded Hot Mix Asphalt Concrete Pavement (Method)"
- Item 360, "Concrete Pavement"
- Item 421, "Hydraulic Cement Concrete"
- Item 440, "Reinforcing Steel."

530.3. Construction. Construct and pave intersections, driveways, and turnouts, and pave existing intersections, driveways, and turnouts as shown on the plans or as directed. Place materials in accordance with construction Articles of pertinent Items. Provide uninterrupted access to adjacent property unless otherwise directed. Ensure that abrupt elevation changes in driveway or turnout areas that serve as sidewalks do not exceed 114 in. and that the sidewalk area cross slope does not exceed 2%. Ready-mix concrete and hand finishing will be permitted when concrete pavement is specified unless otherwise shown in the plans for intersections.

ITEM 531
SIDEWALKS

531.1. Description. Construct hydraulic cement concrete sidewalks.

531.2. Materials. Furnish materials conforming to the following:

- Item 360, "Concrete Pavement"
- Item 420, "Concrete Structures"
- Item 421, "Hydraulic Cement Concrete"
- Item 440, "Reinforcing Steel"

Use Class A concrete or other concrete as specified. Use Grade 8 course aggregate for extruded Class A concrete Use other grades if approved by the Engineer.

531.3. Construction. Shape and compact subgrade, foundation, or pavement surface to the line, grade, and cross-section shown on the plans. Lightly sprinkle subgrade or foundation material immediately before concrete placement. Hand-tamp and sprinkle foundation when placement is directly on subgrade or foundation materials. Remove and dispose of existing concrete in accordance with Item 104, "Removing Concrete." Provide a clean surface for concrete placement directly on the surface material or pavement.

Mix and place concrete in accordance with the pertinent Items. Handfinishing is allowed for any method of construction. Finish exposed surfaces to a uniform transverse broom finish surface. Curb ramps must include a detectable warning surface and conform to details shown on the plans. Install joints as shown on the plans. Brush all exposed surfaces to a smooth and uniform surface. Ensure that abrupt changes in sidewalk elevation do not exceed 114 inch, sidewalk cross slope does not exceed 2%, curb ramp grade does not exceed 8.3%, and flares adjacent to the ramp do not exceed 10% slope. Where a sidewalk crosses a concrete driveway, ensure that the sidewalk depth and reinforcement are not less than the driveway cross-sectional details shown on the plans.

Provide finished work with a well-compacted mass, a surface free from voids and honeycomb, and the required true-to-line shape and grade. Cure for at least 72 hr. in accordance with Item 420, "Concrete Structures."

A. **Conventionally Formed Concrete.** Provide sidewalk sections separated by premold or board joint of the thickness shown on the plans in lengths greater than 8 ft. but less than 40 ft., unless otherwise directed. Terminate workday production at an expansion joint.

B. **Extruded or Slipformed Concrete.** Provide any additional surface finishing immediately after extrusion or slipforming as required on the plans. Construct joints at locations as shown on the plans or as directed.

SECTION 2 - EARTH WORK AND SITE PREPARATION

2.1. SCOPE. This section shall cover the removal and disposal of all materials, in both open cut and tunnel excavations, necessary for performing the work as shown on the drawings or called for in the proposal or special provisions, including sheeting and bracing, drainage, and other work incidental to the preparation of the site for subsequent construction work.

2.2. PREPARATION OF THE SITE. Prior to commencing construction operations, the CONTRACTOR shall make all the provisions necessary to assure the protection of all existing improvements, both public and private. He shall protect trees, shrubs, planting and grass areas and shall make provisions for maintaining public travel in an acceptable manner.

2.3. PROTECTION OF EXISTING IMPROVEMENTS. Before any excavation is started, adequate protection shall be provided for all lawns, trees, shrubs, landscape work, fences, sidewalks, hydrants, utility poles, street, alley and driveway paving, curbs, storm sewers, ditches, headwalls, catch basins, surface inlets and all other improvements that are to remain in place. Such protection shall be provided as long as necessary to prevent damage from the CONTRACTOR'S operations. Shrubs, bushes, small trees and flowers, which have to be removed to permit excavation for the waterline, shall be protected and replanted or replaced when the backfill is completed. The CONTRACTOR shall exercise every precaution to prevent damage to property within and outside easements. He shall remove all debris and rock from the site and restore the ground surfaces to the original grade after proper compaction, replace or repair all driveways, buildings, fences, retaining walls, culverts, drains, pavings, sidewalks, etc. which are removed or damaged during construction. Repair, restoration or replacements of any improvements damaged or removed shall be the obligation of the CONTRACTOR at no additional cost to OWNER.

2.4. PERMITS. OWNER will obtain all necessary permits in public and private rights-of-way from the City of Brownsville, Cameron County, Missouri Pacific Railroad, or the Texas State Highway Department, as required.

2.5. DRAINAGE. The CONTRACTOR shall make provisions for handling all flows in existing creeks, ditches, sewers, and trenches by pipes, flumes or other approved methods at all times when his operations would, in any way, interfere with the natural functioning of said creeks, ditches, sewers and drains. The CONTRACTOR shall at all times during construction provide and maintain sufficient equipment for the disposal of all water which enters the excavation, both in open cut trenches and in tunnels, to render such excavations firm and dry, until structures to be built thereupon are completed.

2.5.1. Methods. Pipe underdrains, well point systems, deep well pump or other suitable equipment and methods shall be used to keep all excavations firm and dry, at no additional cost to the OWNER unless otherwise provided in the proposal.

2.6. EXCAVATED MATERIALS. Materials of excavation shall be classified as earth excavation or as rock excavation and shall include whatever materials are encountered to the depth shown on the drawings, or as directed by the Engineer.

2.6.1. Disposal of Unsuitable Materials. Excavated materials which are neither surplus and not required or are unsuitable for backfilling shall be removed from the site of operations as soon as excavated. All excavated materials so removed shall be disposed of, at no additional cost to the OWNER on privately owned property for which the CONTRACTOR has made prior arrangements and shall not be disposed of on property of the OWNER, unless by permission of the engineer.

2.6.2. Storage of Suitable Materials. Excavated materials suitable and required for backfill shall be stored in neat piles adjacent to the excavation in a manner so as to interfere as little as possible with traffic, but shall not be placed at such heights above or closeness, to the sidewalks of the excavations to endanger such operations due to slides or cave-ins.

2.7. OPEN CUT EXCAVATION. Open cut excavation, in earth or other material, shall be safely supported and of sufficient width and depth to provide adequate room for the construction or installation of the work to the lines, grades and dimensions called for by the drawings.

2.7.1. Trench Preparation. The trench shall be dug so that the pipe can be laid to the alignment and depth required. It shall be excavated only so far in advance of pipe laying as permitted by the City of Los Fresnos. Unless otherwise ordered by the OWNER, all trenches shall be excavated to a width not less than the internal diameter of the pipe, plus 12 inches. The CONTRACTOR shall do all excavation of whatever substances encountered to depths specified. The trench shall be excavated to the depth required so as to provide for the installation of the pipe bedding material to the depth specified on the drawings and elsewhere in these specifications. Bell holes shall be provided at each joint to permit jointing to be made properly and inspected.

2.7.2. Unauthorized Excavation. Excavation shall not be carried below the required level. Excess excavation below the required level shall be backfilled at CONTRACTOR'S expense with earth, sand or gravel as directed by OWNER and shall be compacted to a minimum 95% Standard Proctor density.

2.7.3. Earth Excavation. Earth materials shall be excavated so that the open cut trenches conform with the lines, grades and dimensions shown and/or specified on the drawings.

2.7.3.1. When the bottom of the excavation is unsuitable as a foundation, it shall be excavated below subgrade and then filled with gravel which shall be mechanically compacted in 6" (six inch) layers to a minimum density of 95% Standard Proctor. OWNER will determine depth of removal and replacement of unstable soil. CONTRACTOR shall furnish pumps or well points to keep excavation free of water and also any necessary sheeting, shoring or bracing in conformance with Section 11 of these Standard Specifications to prevent cave-ins. Basis of payment shall be as indicated in the above mentioned specification.

2.7.3.2. Excavated earth materials may be used for a backfill in conformance with the provisions of Section 6 of these Standard Specifications, subject to the approval of the OWNER.

2.8. BORING AND JACKING. Construction of water or sewer lines by boring and jacking methods will be required as specified in the Plans and Specifications. In the event, line and grade cannot be obtained by boring and jacking, the CONTRACTOR will be required, at his expense, to construct a lined mined tunnel in lieu of a tunnel by boring and jacking.

2.8.1. Backstop. The backstop shall be of sufficient strength and shall be positioned

to support the thrust of the boring equipment without incurring any vertical or horizontal displacement during the boring operations.

2.8.2. Guide Rails. The guide rails for the boring equipment may be of either timber or steel. They shall be laid accurately to line and grade and maintained in this position until completion of the boring operations.

SECTION 3 - WATERLINE PIPEWORK

3.1. SCOPE. This section shall cover the furnishing, laying, jointing and testing of all water pipe, including water appurtenances, both in open cut and in tunnels, as shown on the drawings or as directed by the engineer.

3.2. MATERIALS. The material used in pipework shall be furnished by the CONTRACTOR, as approved by the OWNER to meet the requirements of the work of the CONTRACTOR as specified herein.

3.2.1. Water Pipe. Water pipe for main lines may be of any of the following classifications. Any pipe found defective, not meeting the specifications or improperly installed, shall be rejected and so marked and shall be replaced by pipe approved by the OWNER at no additional cost to the OWNER.

3.2.1.1. Polyvinyl chloride pipe for waterline 14 inch to 36 inch shall conform to or exceed AWWA Standards "Polyvinyl Chloride (PVC) Pressure Pipe" C905, Class 100 DR-25, or Class 150 DR-18, latest revision.

3.2.1.2. Polyvinyl chloride pipe for waterlines 4 inch to 12 inch shall conform to or exceed AWWA Standard "Polyvinyl Chloride (PVC) Pressure Pipe" C900, Class 100 DR-25, or Class 150 DR-18, latest revision.

3.2.1.3. Polyvinyl chloride pipe for 2" waterlines shall be Schedule 40 PVC and shall conform to ASTM Standard "Polyvinyl Chloride (PVC) Plastic Pipe: D 1785, latest revision.

3.2.2. Waterline Fittings. Fittings for water lines may be of any of the following classifications. All fittings shall be wrapped in a plastic protector in conformance with AWWA Standard C-105 and ANSI A21.5 "Polyethylene Encasement for Gray and Ductile Cast-Iron piping for Water and Other Liquids," latest revision. Fitting wrapping shall installed in such a manner as to curtail or prevent corrosion of the metallic fittings. Any fittings found defective, not meeting the specifications, or improperly installed, shall be rejected and so marked, and shall be replaced by fittings approved by the OWNER, at no additional cost to the OWNER.

3.2.2.1. Fittings for polyvinyl chloride (PVC) pipe 4 inch through 36 inch shall meet AWWA Standard C-110 or C153 "Ductile-Iron Compact Fitting, 3 inch through 16 inch for Water and Other Liquids," and C104, latest revision, and shall be sized to fit PVC water pipe in conformance with 3.2.1.1 and 3.2.1.2. No adapters for fittings with outside diameters different from PVC pipe shall be used. Fittings shall be mechanical joint type.

3.2.2.2. Fittings for polyvinyl chloride (PVC) Schedule 40 pipe less than 4 inch shall conform to ASTM Standard D2466, latest revision.

3.2.3. Service Connections. Water service connections shall be installed with rubber gasket double strap bronze saddles. "Modified" double strap saddles will not be acceptable substitutes. The service lines and casings shall be of the following classifications. Any material found defective, not meeting the

specifications, or improperly installed, shall be rejected and so marked and shall be replaced with material

approved by the engineer at no additional cost to the OWNER. Service line tubing crossings under travelled roadways shall be installed as specified on the plans with a minimum cover of 36" below roadway surface.

3.2.3.1. Copper tubing for water service lines shall be type "K" and shall conform to ASTM Standard "Seamless Copper Water Tube" B 88, latest revision.

3.2.3.2. Polyvinyl chloride casing for water services lines shall be Schedule 40 PVC and shall conform to ASTM Standard "Polyvinyl Chloride (PVC) Plastic Pipe" D 1785, latest revision.

3.3. PIPE LAYING. All water mains shall be installed as specified in plans with a minimum cover of 48 inches from the top of pipe to an established subgrade. Where pipe is installed beneath railroad tracks, there shall be a minimum vertical distance of 4 feet-0 inches from the top of pipe to top of railroad ties. Construction clearance to cross under railroad trackage will be obtained from Railroad Authority by OWNER. Any expense of bracing or supports to tracks during excavation operation beneath trackage shall be considered part of the contract. Where pipe is installed beneath State Highways, there shall be a minimum vertical distance of 4 feet from top of paving at center line of highway, or 2 feet from top of pipe to bottom of ditch (if existing), whichever is greater. In special locations, Highway Department may require additional cover. Construction clearance and other requirements to cross under State Highways shall be obtained by OWNER.

3.3.1. Procedure. After the trench is excavated to subgrade as specified, it shall be filled to grade as specified in SECTION 6 of these standard specifications. This material shall provide a smooth and uniform pipe bed for the entire length of the waterpipe barrel. Trenching and pipe laying shall be uniformly in a straight line and to uniform elevation unless otherwise specified on plans. Pipe, fittings and valves shall be carefully handled to avoid damage. Before placing pipe into the trench, the outside of the spigot and the inside of the bell shall be wiped clean and dry, free from oil and grease. Every precaution shall be taken to prevent foreign material from entering the pipe. During layout operation, no debris, tools, clothing or other material shall be placed into the pipe. After placing a length of pipe in the trench, the spigot end shall be centered in the bell, the pipe forced home, brought to the correct alignment and covered with an approved backfill material. Metallic tape shall be buried above pipe at a depth of 24 inches below finished grade for location purposes. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a water tight plug or other approved means. This provision shall apply during the noon hour as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.

3.4. PIPE JOINTING. In laying the water pipe to line and grade, the pipe shall be jointed accordance in accordance with one of the following approved jointing methods. OWNER reserves the right, before construction or while construction is in progress, to change the type of joints if its engineer so directs.

3.4.1. Asbestos Cement Pipe Jointing. The CONTRACTOR shall furnish and install asbestos cement pipe in accordance with AWWA Standard "Installation of Asbestos Cement Pressure Pipe" C603-78, latest revision. The machined ends of the pipe to be jointed, coupling grooves and rubber rings shall be cleaned immediately before assembly. Care should be taken not to roll, pinch or reverse the gasket when placed in the bell. Each pipe joint shall be sealed with a coupling consisting of an asbestos cement sleeve and two rubber rings or an equivalent coupling or joint of equivalent strength and performance,

as determined by engineer. The pipe joint shall not be deflected either vertically or horizontally beyond the limits recommended by the manufacturer.

3.4.2. Polyvinyl Chloride (PVC) Pipe Jointing. The CONTRACTOR shall make certain before jointing polyvinyl chloride pipe that the ring groove in the bell of the pipe is clean, with no dirt or foreign material that could interfere with proper seating of the ring. Make sure pipe end is clean. Wipe with a clean dry cloth around the entire circumference from the end to one inch beyond the reference mark. Lubricate the spigot end of the pipe, using only the lubricant supplied by the manufacturer. Be sure the entire circumference is covered. The coating should be the equivalent of a brush coat of enamel paint. It can be applied by hand, cloth, pad, sponge or glove. Do not lubricate the ring groove in the bell because such lubrication could cause ring displacement. The level end is then inserted into the bell so that it is in contact with the ring. Brace the bell, while the level end is pushed in under the ring, so that previously completed joints in the line will not be closed up. The spigot end is pushed until the reference mark on the spigot end is flush with the end of the bell. If undue resistance to inserting of the level is encountered or the reference mark does not reach the flush position, disassemble the joint and check the position of the ring. If is twisted or pushed out of its seat, clean the ring, bell and level end and repeat the assembly steps.

3.5. WET CONNECTIONS. Schedules of existing fittings and proposed new fittings needed to make wet connections to existing waterlines as shown on the plans are estimates only. It is to be recognized that after existing lines and fittings are uncovered, that some discrepancies may occur. When discrepancies occur, the CONTRACTOR shall request a decision by the OWNER as to how the connection in questions shall be made. CONTRACTOR shall plan his work concerning wet connections in such a way that a minimum of inconvenience shall occur to existing water customers due to water service interruptions. Before water service interruptions are made to any customer, CONTRACTOR shall notify designated official and cooperate with operating personnel in every way to minimize service interruptions due to wet conditions. In certain locations, other utility lines or conduit will be obstructing the normal patch of proposed waterlines. In such instances, gravity lines of all kinds hold priority as to grade over water pressure lines, gas lines, electrical conduits, or other obstruction conduits or combinations of conduits which may be encountered. CONTRACTOR is to analyze conditions carefully and then use best judgment in determining proper method of proceeding
through obstructed area with waterline construction, and shall notify the OWNER forty-eight (48) hours in advance of making such connection after obtaining approval from the engineer.

3.6. APPURTENANCES. Appurtenances to the waterline shall be provided and laid in accordance with the drawings and in the manner as specified herein.

3.6.1. Valves. Valves shall be installed at the locations indicated on, and with concrete thrust blocks as specified in the construction drawings, and shall be wrapped in polyethylene as described in 3.2.2., and shall conform to the following requirements:

3.6.1.1. Gate valves shall conform to AWWA Standard "Resilient Seated Gate Valves, 3 inch through 12 inch" C509, latest revision, and shall be utilized for lines 12 inch and smaller, unless otherwise specified in the construction drawings. All gate valves shall be iron body, bronze mounted, double disc parallel seats, non rising stem, internal wedging type, with mechanical joints. Valves must

embody the best workmanship and finish, and open and close freely and easily. In closing, the gates must move without friction to their position opposite their ports, both discs being then closed squarely against the seat rings. When valves are in full open position, the disc shall be raised to clear the waterway and provide an

opening equal to the full nominal diameter of the valves. All gate valves shall open by turning hand wheel or square nut operator counterclockwise. Hydrostatic and leakage tests shall conform to AWWA Standard "Resilient Seated Gate Valves, 3 inch through 12 inch" C509-80, latest revision.

3.6.1.2. Butterfly valves shall conform to AWWA Standard "Rubber Seated Butterfly Valves" C504, latest revision; and shall be Class 150B, mechanical joint ended, and shall be utilized for lines 16 inch and larger, unless otherwise specified in the construction drawings. Valves shall be provided with manual operators with enclosed gear grease housing and hand wheels. Manual operators shall be composed of work gearing, totally enclosed in a grease-packed gear case. Work gears shall be bronze and worm geares shall be hardened steel. Manual operators shall be furnished with devices (externally mounted) to hold the valve in a fixed position for an extended period of time and to indicate valve position. All butterfly valves shall open by turning hand wheel or square nut operator counterclockwise. Hydrostatic and leakage tests shall conform to AWWA Standard "Rubber-Seated Butterfly Valves" C504, latest revision.

3.6.2. Fire Hydrants. Unless otherwise specified, fire hydrants shall conform to AWWA Standard "Dry-Barrel Fire Hydrants" C502, latest revision. Hydrants shall be cast iron, fully bronze mounted and have a working pressure of 150 psi, with mechanical joint-end. Fire hydrants shall have a minimum valve opening of 5-1/4 inch. All fire hydrants shall be located as shown in the plans, and in a manner to provide complete accessibility, and to minimize the possibility of damage from vehicles or injury to pedestrians. All hydrants shall stand plumb with the pumper nozzle facing the curb and the bury line of the hydrant at the finished grade. The barrel of the fire hydrant shall be set so that no portion of the pumper nozzle or hose nozzle will be less than 12 inches from the curb, walkway, or bike patch or more than 20 feet from the face of the curb. The preferred location for the fire hydrant shall be 2 feet clear of the right-of-way line. All fire hydrants shall be placed in accordance with any City or County ordinances. Fire hydrants installed near State Highways shall be in accordance with State Department of Highways and Public Transportation requirements. All fire hydrants shall be connected to the main in the manner shown in the Water Connection Standards.

3.7. TESTING. All newly laid sections of pipe shall be hydrostatically tested at a gauge pressure of 150 psi. CONTRACTOR has the option of running hydrostatic test before or after trench has been completely backfilled. Trenches must be at least partially backfilled before hydrostatic testing to prevent pipe shift. Hydrostatic tests shall be in accordance with AWWA Standard C600 Section 4 "Hydrostatic Testing," latest revision.

3.7.1. Hydrostatic Test Procedure. The CONTRACTOR shall provide all necessary equipment and shall perform all work required in connection with the tests. All pressure pipe, fittings and valves shall be subjected to a hydrostatic pressure of 150 psi. Air pressure testing will not be allowed. The line under test shall be slowly filled with water to the specified test pressure. The lowest elevation point of the section being tested shall be determined and any corrections necessary shall be corrected to the elevation of the test gauge by means of a hand pump, gasoline or electrically driven test pump connected to the pipe. A blow off or fire

hydrant shall be installed at the end of the line under test. Before applying the specified test pressure, all air shall be expelled from the test section including service connections. If hydrants or blowoffs are not available at high places, tap at points of highest elevation shall be made before the test is made and brass plugs inserted after the test has been completed. The required test pressure shall be applied for not less than two (2) hours and longer if ordered by the OWNER. Leakage tests shall be conducted concurrently with pressure tests. OWNER will inspect all pipe, fittings, valves and joints under tests. Any faults found to be due to improper workmanship shall be corrected by the CONTRACTOR at no expense to OWNER.

3.8. STERILIZATION. Pipeline construction shall be in accordance with Section 4 of AWWA Standard C651-01, latest revision. Upon or during completion of the hydrostatic test, the new section of pipe shall be sterilized in accordance with AWWA Standard "Disinfecting Water Mains" C651, latest revision; and the State of Texas Health Standards. Chlorine may be applied by the following methods: Continuous Feed Method and Chlorine Table Method. CONTRACTOR shall provide all equipment and chemicals necessary for sterilization.

3.8.1. Continuous Feed Method. This method is suitable for general application. Water from the existing distribution system or other approved sources of supply shall be made to flow at a constant, measured rate into the newly-laid pipeline. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two rates shall be proportioned so that the chlorine concentration in the water in the pipe is maintained at a minimum of 50 mg/1 available chlorine. During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water. Chlorine application shall not cease until the entire main to be tested if filled with the chlorine solution. The chlorine water shall be retained in the main for at least 24 hours during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24 hour period, the treated water shall contain no less than 25 mg/1 chlorine throughout the length of the main.

3.8.2. Chlorine Tablet Method. Tablet disinfection is best suited to short extensions (up to 2,500 feet and small diameter mains (up to 12 inches). Because the preliminary flushing step must be eliminated, this method shall be used only when scrupulous cleanliness has been exercised. It shall not be used if trench water or foreign material has entered the main or if the water is below 5`C (41`F). Calcium hypochlorite tablets are placed in each section of pipe and also in hydrants, hydrant branches and other appurtenances. They shall be attached by an adhesive, except for the tablets placed in hydrants and in the joints between the pipe sections. All the tablets within the main must be at the top of the main. If the tablets are fastened before the pipe section is placed in the trench, their position should be marked on the section to assure that there will be no rotation. In placing tablets in joints, they are either crushed or placed on the inside annular space or, if the type of assembly does not permit, they are rubbed like chalk on the butt ends of the sections to coat them with calcium hypochlorite. The adhesive may be Permatex No. 1 or any alternative approved by the OWNER. There shall be no adhesive on the tablet except on the broad side next to the surface to which the tablet is attached. Is desired, the calcium hypochlorite may be placed in the pipe in granular form at a rate of one (1) cup (4 fl. oz.) per each pipe. When installation has been completed, the main shall be filled with water at a velocity of less than 1-ft./- sec. This water shall remain in the pipe for at least 24 hours. Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water.

3.8.3. Final Flushing. After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the system, or less than 1 mg/1. Chlorine residual determination shall be made to ascertain that the heavily chlorinated water has been removed from the pipeline.

3.8.4. Bacteriologic Tests. After final flushing, and before the water main is placed in service, a sample or samples shall be collected from the end of the line and tested for bacteriologic quality and shall show the absence of coliform organisms. If the number and frequency or samples is not prescribed by the public health authority having jurisdiction, at least one sample shall be collected from chlorinated supplies when a chlorine residual is maintained throughout the new main. From unchlorinated supplies, at least two samples shall be collected at least 24 hours apart. In the case of extremely long mains, it is desirable that samples be collected the length of the line as well as at its end. Samples for bacteriologic analysis shall be collected in sterile bottles treated with sodium thiosulfate. No hose or fire hydrant shall be used in collection of samples. A suggested sampling tap consists of a standard corporation cock installed in the main with a copper tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.

3.8.5. Repetition of Procedure. If the initial disinfection fails to produce satisfactory samples, disinfection shall be repeated until satisfactory samples have been obtained. The table method cannot be used in these subsequent disinfections. When the samples are satisfactory, the main may be placed in service.

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SECTION 4 - SANITARY SEWER PIPEWORK

Work Included:

4.1. Under this section is included the furnishing, laying, jointing and testing of all sewer pipe, including sewer pipe, including sewer appurtenances, both in open cut and in tunnels, as shown on the drawings or as directed by the engineer.

4.2. MATERIALS.. The materials to be used in pipework shall be furnished by the contractor, as approved by the engineer to meet the requirements of the work of this contract as specified herein.

4.2.1. Gravity Sewer Pipe. Gravity sewer pipe may be of any of the following classifications. Any pipe found defective, not meeting the specifications, or improperly installed shall be rejected and so marked and shall be replaced by pipe approved by the engineer at no additional cost to OWNER.

4.2.1.1. Pipe and fittings shall be manufactured in conformance with the materials and methods described in ASTM Specification D-3084. Joint seals shall be compression type rubber gaskets in compliance with the requirements of ASTM Specification D-1869.

4.2.1.2. Pipe and fittings shall be manufactured in conformance with the materials and methods described in ASTM Specification F-789 and UNI-B-10. Gaskets shall comply with the requirements of ASTM Specification F-477.

4.2.2. Force Mains. Pressure sewer pipe may be of any of the following classifications. Any pipe found defective, not meeting the specifications, or improperly installed shall be rejected and so marked and shall be replaced by pipe approved by the engineer at no additional cost to OWNER.

4.2.2.1. Polyvinyl chloride pipe for force mains shall conform to AWWA Standard "Polyvinyl Chloride (PVC) Pressure Pipe" C-900 - 750 Class 100 DR25, latest revision. Fittings for polyvinyl chloride (PVC) pipe shall be "Compact Fittings" short body, tar coated (not cement lined). Transition gaskets shall also be included, unless otherwise noted on the contract bid document or drawings.

4.2.3. Watertight Joint Materials. The contractor must exert every reasonable effort to secure a watertight joint and prevent infiltration of ground water into or exfiltration of sewage out of all pipe sewers and property service connections. To achieve this, joint material shall be made of the materials as specified herein, unless otherwise set forth in Special Provisions or Proposal. Any joint materials found to be defective or not meeting the specifications shall be rejected and replaced by approved joint materials at no additional cost to OWNER.

4.2.3.1. Factory fabricated joints for vitrified clay pipe shall be made in accordance with ASTM Standards for "Compression Joints for Vitrified Clay Bell and Spigot Pipe," C-425, Round-o-Ring type, latest revision; however, the rubber gaskets shall meet the specific test requirements set forth in Section 4.2.3. of the specifications under "Quality of Rubber Gaskets."

4.2.3.2. All rubber gaskets used in jointing vitrified clay pipe shall meet the following requirements:

1. Tensile Strength (ASTM D-412) Min. 2,300 psi
2. Elongation at Break (ASTM D-412) Min. 425%
3. Shore Durometer, Type A (ASTM D-676) 40, +5
4. Compression Set (ASTM D-395 Method B) Max. 15%
5. Water Absorption (ASTM D-471) Max. 5%
6. Specific Gravity (ASTM D-297) Max. var. + 0.03%
7. Ozone Resistance Rating (ASTM D-1171)1
   Properties after Air Oven Aging (96 hrs. at 158° F.)
8. Tensile Strength (ASTM D-412) 85% of Original
9. Elongation (ASTM D-412) 80% of Original.

The pipe manufacturer shall submit a "Statement of Findings," which shows the results of the above test for each shipment of pipe. It shall be the contractor's responsibility to require the above tests of the gaskets and to furnish the required "Statement of Findings" to OWNER. Gaskets shall be rubber; neoprene is not acceptable.

4.2.3.3. Water stop joints shall be Polyvinyl Chloride (PVC) or other similar approved joint materials.

4.3. Property service connections shall be installed using Polyvinyl Chloride Pipe (PVC). The pipe shall be SDR-35 and shall be manufactured in accordance with ASTM D-3034. The joints shall be compression type rubber gasket joints conforming to ASTM D-1869. The location of all laterals and service lines shall be shown on the plans. Where not approved street grade has been established, the depth of the connection shall be based on the assumed future street grade or on the present street or ground surface, as determined by the engineer. At times when pipe laying is not in process, the open ends of the pipe shall be closed by a watertight plug or other approved means. This provision shall apply during the noon hour as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.

4.4. Sewer Pipe Laying Procedures. After the trench is excavated to a subgrade as specified, it shall be filled to grade with a minimum 6 inch gravel layer. This material shall be mechanically tamped to a density minimum of 90%. This material shall provide a smooth and uniform pipe bed for the entire length of the sewer pipe barrel. Ditching and pipe laying shall be uniformly in a straight line and to uniform elevations, unless otherwise specified on the plans. Pipe and fittings shall be carefully handled to avoid damage. Before placing pipe into the trench, the outside of the spigot and the inside of the bell shall be wiped clean and dry, free from oil and grease. Every precaution shall be taken to prevent foreign material from entering the pipe. During layout operation, no debris, tools, clothing or other material shall be placed into the pipe. After placing a length of pipe into the trench, the spigot end shall be centered in the bell, the pipe forced home, brought to the correct alignment and covered with an approved backfill material. When the pipe is installed, metallic tape shall be buried 1 foot above top of pipe for location purposes.

4.5. Pipe Jointing. In laying the sewer pipe to line and grade, the pipe shall be jointed in accordance with one of the approved jointing methods. OWNER reserves the right, before construction is in progress, to change the type of joints if its engineer so directs.

4.5.1. Vitrified Clay Pipe Jointing. The contractor shall furnish and install Vitrified Clay Pipe with factory-fabricated joints and rubber gaskets (see Section 4.2.3. of the Specification for joint material requirements). After the pipes are aligned in the trench and are ready to be jointed, all joint surfaces shall be thoroughly cleaned. The groove and the rubber gasket shall be lubricated, if and as required by the manufacturer's instructions and the rubber gasket placed in the groove. Then the bell and/or gasket shall be lubricated, if and as required; and the pipe shall then be carefully pushed or pulled home into place by an approved method, without damage to pipe or gasket, to form a watertight joint. Suitable devices shall be used to join the pipes together so that they will fit with a minimum open recess inside and outside and have tightly sealed joints. Care shall be taken not to use force to wedge apart and split bell or groove ends.

4.5.2. Polyvinyl Chloride Pipe (PVC) Jointing. The contractor shall make certain before jointing polyvinyl chloride pipe that the ring groove in the bell of the pipe is clean with no dirt or foreign material that could interfere with proper seating of the ring. Make sure pipe end is clean. with a clean dry cloth around the entire circumference from the end to one (1) inch beyond the reference mark. Lubricate the spigot end of the pipe, using only the lubricant supplied by the manufacturer. Be sure the entire circumference is covered. The coating shall be the equivalent of a brush coat of enamel paint. It can be applied by hand, cloth, pad, sponge, or glove. Do not lubricate the rubber ring or the ring groove in the bell because such lubricant could cause ring displacement. The level end is then inserted into the bell so that it is in contact with the ring. Brace the bell, while the level end is pushed in under the ring, so that previously completed joints in the line will not be closed up. The spigot end is pushed until the reference mark on the spigot end is flush with the end of the bell. If undue resistance to insertion of the level end is encountered or the reference mark does not reach the flush position, disassemble the joint and check the position of the ring. If it is twisted or pushed out of its seat, lean the ring, bell and level end and repeat the assembly steps.

4.6. Sewer Appurtenances. Appurtenances to the sewer shall be provided and laid in accordance with the drawings and in the manner as specified herein. Appurtenances in addition to those required by the drawings or the proposal, as approved or directed by the engineer, shall be paid for under the appropriate items of the proposal.

4.6.1. Branches and Fittings. Branches and fittings shall be provided and laid as and where directed. T-branches and Y-branches, placed in the sewer for property service connections, shall be located by the contractor, as directed by the engineer, at such points in the sewer so as to result in the property service connection having the shortest length possible between the sewer and property line or easement line, unless otherwise indicated on the drawing or directed by the engineer.

4.6.2. Stubs. Stubs for future sewer pipe shall be installed as indicated by the drawings. If the specified length of the stub is exceeded, there will be no additional cost to OWNER unless the extra length is ordered by the engineer. Existing sewer pipe stubs shall be removed as required, but only when directed by the engineer.

4.6.3. Stacks. Stacks shall be constructed as and where directed. The height of the stack shall be as indicated on the drawings, set forth in the proposal, as determined by the engineer. The stack shall be encased in concrete in accordance with the "Typical Sewer Details" drawings.

4.6.4. Drop Inlets. Drop inlets to the manhole shall be constructed as and where indicated by the drawings or either of the types shown on the "Typical Sewer Details" drawings, as directed by the

engineer.

4.6.5. Cleanouts. Cleanouts on all service laterals shall be installed at the location shown on the plans and in accordance with the Wastewater Construction Standards.

4.6.6. Manholes. Manholes shall be constructed of the type shown on the "Typical Sewer Details" drawings to the elevations shown on the plan-profile sheets, or as directed. The manholes specified shall be Glass Fiber-Reinforced Polyester Manholes for use in sanitary sewer applications. They shall be a one-piece unit of one class, fabricated in a composite laminate. Walls shall be of uniform thickness and shall be free from thin spots and voids. Exterior surface shall be free of ridges and sharp protrusions and reinforcement. Interior surface shall also be smooth and free of ridges so as to facilitate self-cleaning. The exterior surface shall be covered with graded sand to facilitate bonding to the concrete base pad, cement stabilized sand backfill and cement grout used to seal around all incoming lines. The main line over which the manhole cut-out will be set shall be fitted with a seal ring as manufactured by Johns-Manville Manufacturing or equal. The manholes shall conform to ASTM D. 3753-81, Standard Specifications for Glass Fiber-Reinforced Polyester Manholes and all noted applicable documents. Materials, method of manufacture and manufacturing requirements must all conform to the above mentioned specification. The manufacture shall submit written certification that their product meets the requirements of ASTM D. 3753-81 with test results of specified manholes included.

4.6.7. Stoppers and Bulkheads. Open ends of pipes and branches small than 15 inches in diameter shall be sealed with stoppers, cemented into place in an acceptable manner using a rubber gasket between the stopper and socket. (See Section 4.5.1.). Openings 15 inches in diameter and larger shall be closed with brick bulkheads at least 4 inches thick or by other approved methods as authorized. All openings to the pipeline shall be satisfactorily protected from the entrance of earth, water or other material. If a temporary bulkhead is constructed to prevent sewage from backing into the trench excavation or to prevent foreign material from entering the sewer from the new sewer trench, the Contractor shall be responsible for reconstructing, repairing, or replacing those portion of the existing sewers removed or damaged by his operations. Existing bulkheads shall be removed as indicated by the drawings or set forth in the proposal, but not until directed by the engineer.

4.7. Air Testing. T his shall cover the testing of completed sections of installed air pressure. The contractor shall conduct low air pressure tests on completed sections of sewer mains. The air test results will be used to evaluate materials and construction methods on the pipe line sections, and successful air tests shall be mandatory for the acceptance of the lines.

4.7.1. Materials for Air Testing. The following materials will be utilized for air testing sewer mains.

4.7.1.1. Compressor Air Supply: Any source which will provide at least three hundred (300) cubic feet per minute at one hundred (100) pounds per square inch. The compressor air supply shall be furnished by the contractor.

4.7.1.2. Plugs , valves, pressure gauges, air hose, connections and other equipment necessary to conduct the air test shall be furnished by the owner. The test equipment for air testing will consist of valves, plugs, and pressure gauges used to control the rate at which air flows to the test section and

to monitor the air pressure inside the plugs. Test equipment shall be assembled as follows:

a. hose connection
b. shut off valve
c. throttle valve
d. pressure reduction valve
e. monitoring pressure gauge

4.7.2. Test procedures. The following procedures will be utilized for air testing sewer mains:

4.7.2.1. Determine section of line to be tested.

4.7.2.2. Apply air pressure until the pressure inside the pipe reaches 4 psig.

4.7.2.3. Allow the pressure inside the pipe to stabilize, then bleed back to 3.5 psig.

4.7.2.4. At 3.5 psig., the time, temperature and pressure will be observed and recorded. A minimum of five (5) readings will be required for each test. If the time in seconds for the air pressure to decrease from 3.5 psig to 2.5 psig is greater than that shown in the following table, the pipe shall be presumed to be free from defect. When these rates are exceeded, pipe breakage, joint leakage, or leaking plugs are indicated and an inspection must be made to determine the cause. The contractor shall effect such repairs as may be required to accomplish a successful air test.

Table 1 minimum Test Time for Various Pipe Sizes

Nominal Pipe Size, in.	T(time) min/100 ft.	Nominal Pipe Size, in.	T(time) min/100 ft.
3	0.2	21	3.0
4	0.3	24	3.6
6	0.7	27	4.2
8	1.2	30	4.8
10	1.	33	5.4
12	1.8	36	6.0
15	2.1	39	6.6
18	2.4	42	7.3

4.8. Leakage Test. A leakage test may be requested by the engineer at any time to determine whether or not there is excessive infiltration and to assure that the sewer section is sub-stantially watertight. The engineer may order the contractor to make leakage tests of as many sections as may be necessary to determine whether the work complies with the criteria for the rate of leakage. A section shall consist of

a reach from one manhole to the next manhole provided the manholes are at least 300 feet apart and preferable 400 feet. Leakage tests shall be conducted, and measurements made, for a minimum of one hour. The tests may be conducted over a longer period of time with no reduction in the rate of leakage.

4.8.1. Leakage into the Sewer. Leakage into the sewer including manholes, shall not exceed a rate of 250 gallons per 24 hours per inch diameter per mile of sewer. There shall be no gushing or spurting streams entering the sewer or manhole and where encountered they shall be repaired regardless of the rate of infiltration at no additional cost to OWNER. Where practicable, the tests for leakage into the sewers shall be made at a time when the groundwater level is at a maximum, but it must be at least one foot above the top of the pipe of the highest elevation in the section being tested.

4.8.2. Leakage out of the Sewer. Where the groundwater level is less than one foot above the top of the pipe and where conditions will permit, the sewers shall be subjected to an internal pressure by plugging the pipe at both ends and then filling the sewer and manholes with clean water to a height above the top of the pipe sufficient to obtain satisfactory measurements to determine the rate of leakage. The rate of leakage from the sewers may be determined by either the amount of subsidence in the water surface level of the amount of water required to maintain the original water surface level above the top of the pipe. Leakage from the sewers as specified in Section 4.8.1., except that an allowance of an additional 10 percent of gallonage shall be permitted for each additional 2 feet of head over a basic 2 foot minimum internal head.

4.8.3. Requirements of the Contractor. The contractor shall construct such weirs or other means of measurements as may be required, shall furnish water and shall do all necessary pumping to enable the tests to be properly made. When a leakage test fails, the contractor shall do such other work as may be necessary until the rate of leakage meets the above requirements, as determined by additional leakage tests.

4.9. Deflection Testing for Gravity PVC Sewer Lines. No sooner than 30 days, nor later than 12 months after the pipe has been installed and backfilling has been completed, tests for deflection shall be made. A deflection of more than 5 percent of the inside diameter of the pipe shall be cause for rejection, and the line will be removed and replaced at the contractor's expense. A GO NO-GO Deflection Testing Mandrel, to be furnished by the contractor, and certified by the engineer, shall be used. The testing shall consist of the following:

1. Completely flush the line, if required, making sure the pipe is clean of any mud or debris that would hinder the passage of the mandrel.
2. During the final flushing of the line, attach a floating block or ball to the end of the mandrel pull rope and float the rope through the line.
3. After the rope is threaded through the line, connect the pull rope to the mandrel and place the mandrel in the entrance of the pipe.
4. Connect a retrieval rope to the back of the mandrel to pull it back if necessary.
5. Remove all slack in the pull rope and place a tape marker on the rope at the ends of the pipe where the mandrel will exit, determining the location of the mandrel in the line.
6. Using manhole guide pulleys, draw mandrel through the sewer line, if any irregularity of pipe deformation exceeding the allowable 5 percent is encountered in the line, the line shall be uncovered at the point.

7. If an obstructed or over-deflected section is found, locate it; dig down and uncover pipe; inspect the pipe; if any damaged pipe is found, replace it. If pipe is not damaged, re-round the pipe, replace and thoroughly tamp the embedment and initial backfill; replace remainder of backfill.
8. Re-test this entire section for deflection.
9. Any pipe removed shall be replaced by use of gasketed repair couplings. Each and every deflection

test shall be conducted in the presence of the owner's or engineer's representative.

SECTION 6 - BACKFILL

6.1. WORK INCLUDED. Under this section is included the filling of excavated trenches and spaces around the completed structures to the original grades, unless otherwise shown on the drawings or set forth in the proposal.

6.2. OPEN CUT BACKFILL. Backfilling of excavated trenches in open cut shall be commenced as soon as possible after the water or sewer line is laid and the jointing and alignment are approved, but not until authorized by the OWNER.

6.2.1. Materials. The following materials shall be used to backfill the trenches in accordance with and in the manner indicated by the requirements specified herein, unless otherwise set forth in drawings or proposal.

6.2.1.1. Sandy Backfill Materials. Backfill in trenches for waterlines, sewer lines, property sewer service connections, and structures within the limits of existing or proposed paved surfaces shall be made with sand or sandy materials containing not more than 20 percent clay, and free from rocks, lumps and debris. The sand or sandy material shall be furnished by the CONTRACTOR, but shall be subject to the approval of the OWNER.

6.2.1.2. Selected Excavated Materials. Backfill in trenches for waterlines, sewer lines, property sewer connections, and structures outside the limits of existing or proposed paved surfaces, shall be made with selected excavated materials taken from the trench excavation, free from rocks and lumps greater than six (6) inches in their largest dimension, and free from debris. The OWNER will, at his discretion, reject any material he deems unsuitable for backfill.

6.3. BEDDING PROCEDURES. The following bedding procedures will be used for Polyvinyl Chloride (PVC) Pipe, Asbestos Cement Pipe and Vitrified Clay Pipe. Before pipes have been tested and approved, partial backfilling shall be done with approved material free from large clods.

Sand bedding zone shall extend from a point at least 6 inches below bottom of pipe to a point at least 6 inches above top of pipe, as well as at least 6 inches on each side of pipe and shall be compacted to at least 90% of maximum density as determined by ASTM Standard D698, latest revision.

Sand bedding from 6 inches below bottom of pipe to bottom of pipe shall be placed in one lift and shall be mechanically tamped. Sand bedding from bottom of pipe to spring line of pipe shall be placed by hand in 4 inch lifts and shall be hand tamped with proper tools. Sand bedding from spring line of pipe to 6 inches above top of pipe shall be placed in 6 inch lifts and shall be mechanically tamped.

When trench bottom is unstable, or when pipe is to be placed under groundwater (below water table), foundation preparation shall be required, preferably with ground water drawdown procedures. If drawdown equipment is not used or gravel stabilization or approved substitute shall be required and no pipe will be laid until stabilization is to the satisfaction of the OWNER.

6.3.1. Final Backfill Above Pipe Zone (6"Above Pipe or Conduit to Top of Ground). The backfill above the pipe zone shall be, until otherwise indicated on the drawings, in accordance with the following.

6.3.1.1. Class "A" Mechanical Compaction. Trench under flexible pavements and gravel surfaces - place Type "D" sand backfill material in layers not to exceed six (6) inches loose measurement. Compact with mechanical tampers to a dry density of at least 95% of maximum density as determined by ASTM Standard D698, latest revision. Each layer, before compaction, shall be leveled and evenly distributed on both sides of the pipe so as not to disturb, displace or damage the water or sewer line in any way. When the material does not contain sufficient moisture to obtain thorough compaction, it shall be moistened or wetted as directed by the OWNER. Use under proposed road.

6.3.1.2. Class "B" Mechanical Compaction. Trench under unimproved roadways, unsurfaced road shoulders, unimproved driveways and under turfed or seeded lawn areas- place Type "E" excavated material in backfill layers not to exceed twelve (12) inches loose measurement. Compact with mechanical tampers to at least 90% of maximum density as determined by ASTM Standard D698, latest revision. Each layer, before compaction, shall be leveled and evenly distributed on both sides of the pipe so as not to disturb, displace or damage the water or sewer line in any way. When the material does not contain sufficient moisture to obtain thorough compaction, it shall be moistened or wetted as directed by the OWNER.

6.4. SPECIAL BACKFILL CONDITIONS The trenches need not be completely back- filled until all required pressure and leakage tests are performed and until the utilities system as installed conform to the requirements specified.

Trenches improperly backfilled shall be reopened to the depth required for proper compaction, and refilled and compacted as specified, or the condition shall be otherwise corrected as permitted by the OWNER. The surface shall be restored to its original condition as nearly as practicable and as hereinafter specified. Immediately after the pipe, or utility lines, is bedded and joined, as indicated on the drawings or specified, the backfill material shall be deposited within the pipe zone in uniform layers not to exceed (6) inches at the proper moisture content. The layers shall be compacted with mechanical hand tampers or other approved equipment to the density herein specified. The backfill shall rise the same on each side of the pipe and coincidentally be tamped in layers until there is a cover of 12 inches over the top of the pipe. Walking or working over the pipe will not be permitted until the trench is backfilled to 12 inches above the pipe.

Where pavement on a State Highway is cut, final backfill material and pavement shall be replaced in accordance with State Highway Department requirements.

Where pavement is cut in locations other than State Highways, whether gravel topping or hard surfaced, the surfaced shall be restored to its original finish and in equal condition and quantities as found at the beginning of construction. Trenches on hard surfaced roads and State Highways shall be backfilled to a density of 95% as determined by the American Association of State Highway Officials Method T99 for compaction and density of soils.

Successful CONTRACTOR shall determine all requirements of various controlling agencies in connection with backfilling, pavement replacement and general construction before starting construction.

In traffic areas including individual driveways, CONTRACTOR shall restore traffic surfaces to usable condition immediately upon completion of pipe installation. In such locations, OWNER will rely upon hydrostatic test to determine acceptability of construction. All excess dirt from all construction work shall be disposed of promptly by CONTRACTOR, either by hauling or at directions of OWNER.

6.5. BACKFILLING AT STRUCTURE. Shall not begin until construction below finish grade has been approved, undergound utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicate finish grade. All forms, shoring and bracing shall be removed before backfilling is started. Care shall be taken to prevent any wedging action of backfill against a structure, and slopes bounding the excavation shall be stepped or serrated to prevent such wedge action. Backfill shall be placed in uniform layers, dried or moistened as required to obtain approximate optimum moisture content, and tamped with mechanical hand tampers or other approved equipment to a density of at least 95 percent of maximum density at optimum moisture. The thickness of each loose layer shall not exceed six inches.

6.5.1. Backfilling Walls of Lift Station Structures. During backfilling operations and in the formation of embankments, equipment that will overload the structure in passing over and compacting these fills shall not be use. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 6 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. Backfill shall be brought up to finished elevation indicated on drawings, on each side of the wall. Foundation walls shall be backfilled in a maximum of 3'-0" intervals until finished grade has been established.

6.6. COMPACTION - General. Backfill materials shall be placed in uniform layers and compacted to percentage of density hereinafter specified. Moisture shall be controlled between optimum and 2 percentages points over. Methods to secure optimum moisture content shall be CONTRACTOR'S responsibility. Compacting equipment and method of compaction shall be the responsibility of CONTRACTOR and shall be such that uniform density will be obtained over entire area and depth of material being compacted. Fill material shall be thoroughly broken up before being spread into uniform layers.

Backfill not otherwise specified shall be compacted to at least 95% of maximum density as determined by ASTM Specification D698.

6.7. DETERMINATION OF DENSITY. Determination of density of backfill, shall be made in conformance with the requirements of ASTM D2922, ASTM D1556 or ASTM D2167.

Determination of density of cohesionless material shall be made in accordance with ASTM D2049. Relative density of 75% shall be considered as satisfactory for cohesionless material.

Testing shall be performed by a soil consultant employed by the OWNER and at no expense to the CONTRACTOR to test compaction of backfill material. When soil tests indicate densities less than those specified by this section, the material shall be recompacted and tested at the CONTRACTOR'S expense.

6.8. CONSTRUCTION EQUIPMENT. Ditching machines will be permitted at CONTRACTOR'S option, subject to the approval of the OWNER, whenever their use is applicable and practical for work shown on the drawings. A certain amount of hand excavation may be required due to special field conditions and to minimize damage to improvements and trees.

In compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Any pipe damaged thereby shall be repaired or replaced at the option of the OWNER and at the expense of the CONTRACTOR.

6.9. RESTORATION AND CLEANUP. The CONTRACTOR shall restore or replace all removed or damaged paving, curbing sidewalks, gutters, shrubbery, fences, sod, or other disturbed surfaces of structures in a condition equal to that before the work began and to the satisfaction of the OWNER and shall furnish all labor and material incidental thereto, in restoring improved surfaces, new pavement shall be laid. No permanent surface shall be placed within 30 days after the backfilling has been completed, except by order of the OWNER.

Surplus pipeline material, tools and temporary structures shall be removed by the CONTRACTOR. All dirt, rubbish, and excess earth from excavations shall be hauled to a dump provided by the CONTRACTOR, and the construction site shall be left clean, to the satisfaction of the OWNER.

SECTION 11 - CONTRACTOR'S TRENCH EXCAVATION SYSTEM AND SHORING SAFETY PLAN

11.1. SCOPE. This item shall cover CONTRACTORS furnishing a Safety System Plan, and all labor and materials for installation and maintenance of the Trench Safety System.

11.2. APPLICATION. For any trench excavation at a depth of five (5) feet or greater or where shown on plans, provide trench safety system. Trench safety system shall be in accordance with details shown on CONTRACTOR'S Trench Excavation and Shoring Safety Plan.

11.3. QUALITY ASSURANCE. Trench Safety System to meet appropriate requirements established in Section 756.022 of the Texas Health and Safety Code and Occupational Safety and Health Administration (OSHA) Safety & Health Regulations, 29 CFR 1926, Subpart P - Excavations, Trenching and Shoring, as may be amended, and OSHA's proposed standard on trenching excavation published in Volume 54, Page 209, of the Federal Register, October 31, 1989; Pages 45959-45991. Those standards are incorporated into these specifications by reference. Should the applicable OSHA standards be modified or amended, the more stringent standards shall apply.

11.4. SUBMITTALS. The CONTRACTOR shall provide Trench Safety System Plan for Project prior to Award of the Contract. The Plan shall incorporate the detailed plans and specifications for a Trench Safety System conforming to OSHA standards. The Plan shall account for project site conditions, CONTRACTOR's trench construction means, methods, techniques or procedures, the relationship of spoil to edge of trench, and CONTRACTOR's equipment to be used in construction of project facilities requiring trench Safety System(s). CONTRACTOR shall submit a certificate signed and sealed by a Registered Professional Engineer licensed in the State of Texas stating that CONTRACTOR's Trench Safety System Plan has been designed in conformance with appropriate OSHA standards and applicable specifications as required by this item. CONTRACTOR's Trench Safety System Plan shall demonstrate the type(s) of Trench Safety System to be used on the project.

11.5. MATERIALS. The materials used in the Trench Safety System shall be furnished by the CONTRACTOR, as approved by the OWNER, to comply with the requirements of the work of the CONTRACTOR as specified therein.

11.5.1. Timber. Trench sheeting materials to be full size, a minimum of two inches in thickness, solid and sound, free from weakening defects such as loose knots and splits.

11.5.2. Steel Sheet Piling. Steel sheet piling shall at a minimum conform to one of the following specifications:

a. ASTM A328.
b. ASTM A572, Grade 50.
c. ASTM A690.

Steel for stringers (wales) and cross braces shall conform to ASTM A588.

11.5.3. Steel Trench Boxes. Portable steel trench box shall at a minimum be constructed of steel conforming to ASTM Specification A-36. Connecting bolts used shall conform to Specifications ASTM A-307. Welds to conform to requirements of AWS Specification D1.1.

11.5.4. Other Materials. Other materials to be utilized shall at a minimum conform to applicable ASTM standards.

11.6. INSTALLATION. Trench safety system shall be constructed, installed, and maintained in accordance with the Trench Safety System Plan prepared by the CONTRACTOR'S Registered Professional Engineer.

11.6.1. Timber Sheeting. Timber sheeting and size of uprights, stringers (wales), and cross bracing to be installed in accordance with CONTRACTOR'S plan. Place cross braces in true horizontal position, spaced vertically, and secured to prevent sliding, falling, or kickouts. Cross braces to be placed at each end of stringers (wales), in addition to other locations required. Cross braces and stringers (wales) to be placed at splices of uprights, in addition to other locations required.

11.6.2. Steel Sheet Piling. Steel sheet piling of equal or greater strength may be used in lieu of timber trench shoring shown in the OSHA tables (proposed standards). Drive steel sheet piling to at least minimum depth below trench bottom as recommended by CONTRACTOR'S Registered Professional Engineer providing design. Place cross braces in true horizontal position, spaced vertically and secured to prevent sliding, falling, or kickouts. Cross braces to be placed at each end of stringers (wales), in addition to other locations required.

11.6.3. Trench Boxes. Portable trench box may be used in lieu of timber trench shoring shown in the OSHA tables (proposed standards) and shall be designed to provide equal or greater protection than timber trench shoring shown in the OSHA tables. In cases where top of portable trench box will be below top of trench, the trench must be sloped to the maximum allowable slope for the soil conditions existing on the Project. In areas where a sloped trench will affect the integrity of existing structures, CONTRACTOR to protect structures prior to sloping trench.

11.6.4. Trench Jacks. When trench jacks are used for cross bracing and/or stringers (wales), the trench jacks shall provide protection greater than or equal to the timber cross bracing shown in the OSHA tables (proposed standards). Trench jacks to be placed at each end of stringers (wales) in addition to other locations required.

11.7. SUPERVISION. CONTRACTOR must provide competent supervisory personnel at each trench while work is in progress to ensure CONTRACTOR'S methods, procedures, equipment, and materials pertaining to the safety systems in this Item are sufficient to meet requirements of Texas Law and OSHA Standards.

11.8. MAINTENANCE OF SAFETY SYSTEM. The safety system shall be maintained in the condition as shown on the Trench Excavation and Shoring Safety Plan as designed by the CONTRACTOR'S Registered Professional Engineer. The CONTRACTOR shall take all necessary precaution to ensure the safety systems are not damaged during their use. If at any time during its use a safety system is damaged, personnel shall be immediately removed from the trench excavation area and the safety system repaired. The CONTRACTOR shall take all necessary precautions to ensure no loads, except those provided for in the plan, are imposed upon the trench safety system.

11.9. INSPECTION. CONTRACTOR shall make daily inspection of trench safety system to ensure that the system meets OSHA requirements. Daily inspection to be made by competent personnel. If evidence of possible cave-ins or slides is apparent, all work in the trench shall cease until necessary precautions have been taken to safeguard personnel entering trench. CONTRACTOR to maintain permanent record of daily inspections.

11.10. REMOVAL. Bed and backfill pipe to a point at least one (1) foot above top of pipe or other embedded items prior to removal of any portion of trench safety system. Bedding and backfill to be in accordance to other applicable specification items. Backfilling and removal of trench supports shall be in accordance with CONTRACTOR'S Trench Excavation and Shoring Safety Plan. Removal of trench safety system to be accomplished in such a manner to cause no damage to pipe or other embedded items. Remove no braces or trench supports until all personnel have evacuated the trench. Backfill trench to within five (5) feet of natural ground prior to removal of entire trench safety system.

SECTION 02060 - DEMOLITION

PART 1 - GENERAL:

SUBMITTALS:
The procedures proposed for the accomplishment of salvage and demolition work shall be submitted for approval. The procedures shall provide for safe conduct of the work, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations.

GENERAL REQUIREMENTS:
The work includes demolition or removal of all construction indicated or specified. All materials resulting from demolition work, except as indicated or specified otherwise, shall become the property of the Contractor and shall be removed from the limits of the property. Rubbish and debris shall be removed from the property daily unless otherwise directed so as to not allow accumulation inside or outside the building. Materials that cannot be removed daily shall be stored in areas specified by the Architect.

DUST CONTROL:
The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the building and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

PROTECTION:
1. Protection of Existing Work: Before beginning any cutting or demolition work, the Contractor shall carefully survey the existing work and examine the drawings and specifications to determine the extent tot the work. The Contractor shall take all necessary precautions to insure against damage to existing work to remain in place, to be reused, or to remain the property of the owner, and any damage to such work shall be repaired or replaced as approved by the Architect at no additional cost to the owner. The Contractor shall carefully coordinate the work of this section with all other work and construct and maintain shoring, bracing and supports, as required. The Contractor shall insure that structural elements are not overloaded and be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under any part of this contract.

2. Protection of building from the Weather: The interior of the building and all materials and equipment shall be protected form the weather at all times.

3. Protection of Trees: Trees within the project site which might be damaged during demolition and which is indicated to be left in place shall be protected by a 6-foot high fence. The fence shall be securely erected a minimum of 5-feet from the trunk of individual trees of follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the work under this contract shall be replaced.
4. Environmental protection: All work and Contractor operations shall comply with the requirements of SECTION: ENVIRONMENTAL PROTECTION.

BURNING: The use of burning at the project site of the disposal of refuse and debris will not be permitted.

USE OF EXPLOSIVES: Use of explosives will not be permitted.

PART 2 - EXECUTION:

EXISTING FACILITIES:

1. Structural, Walls, and Partitions: Existing walls and partitions indicated shall remain.

DISPOSITION OF MATERIAL:

1. Title of Materials: Title to all materials and equipment to be demolished, excepting owners salvage and historical items, is vested in the Contractor upon receipt of notice to proceed. The owner will not be responsible for the condition, loss or damage to such property after notice to proceed.

2. Material for Contractor Salvage: Material for salvage shall be stored as approved by the Architect. Salvage materials shall be removed form Owner's property before completion of the Contract. Material for salvage shall not be sold on the site.

CLEAN UP:

1. Debris and Rubbish: Debris created by the demolition of existing roofs shall be removed form site and buildings.

2. Debris Control: Debris shall be removed and transported in a manner as to prevent spillage on streets or adjacent areas.

3. Regulations: Local regulations regarding hauling and disposal apply.

END OF SECTION 02060

SECTION 02110 - SITE PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Site preparation shall include furnishing necessary equipment and labor to remove vegetation and rubbish and the placement of approved excess excavation in conformity with the lines, grades, dimensions, and details shown on the Contract Documents.

B. Within limits shown on the Contract Documents, or in areas where existing grade is altered, strip existing topsoil to a depth of 6-inches and stockpile in approved areas for subsequent replacement. Contractor to remove and dispose of all excess materials.

1.2 RELATED SECTIONS

A. Section 02060 - Demolition

1.3 REFERENCES

A. ASTM D698-1991: Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft [600 kN-m/m]).

1.4 DEFINITIONS

A. Borrow. Material taken from designated areas to make up any deficit of excavated material.

1.5 SUBMITTALS AND WORK

A. Coordinate activities with other work being performed so as not to cause any interruption of activities being completed under other Sections of the Contract Documents.

1.6 REGULATORY REQUIREMENTS

A. Work under this Section shall conform to applicable City Regulations for disposal of debris, including safety requirements during performance of the work.

B. Work under this Section shall be coordinated with utility companies and any the management of any existing facilities in order to prevent any disruption in operation and/or utility service.

C. Permits, fees, disposal charges and licenses shall be secured and paid by Contractor.

PART 2 - PRODUCTS

2.1 MANUFACTURER(S) (not used)

2.2 EQUIPMENT

A. The Contractor may use equipment and materials necessary to properly complete the tasks described under this Section.

2.3 MATERIALS

A. Fill:

1. Source: Obtain embankment fill from required excavation or, if excavated material is insufficient, from borrowed areas approved by the Geotechnical Engineer.

2. Suitability: Use the best material available from excavation or borrow. Suitability of fill material is subject to the Geotechnical Engineer's approval.

3. Quality: Fill material must be free of excessive silts. Do not use soil containing brush, roots, sod or similar perishable material.

4. Excess Excavation: Use excess excavation or borrowed material with prior approval of the Engineer. Borrow material from the approved source and excavate. On completion of work borrowed area to be cleaned and dressed. Reuse of material stripped from borrow site is not allowed unless specifically indicated on the Drawings.

2.4 FABRICATION (not used)

2.5 QUALITY CONTROL

A. Fill materials to be acquired as specified in Plans and/or by the Geotechnical Engineer.

PART 3 - EXECUTION

3.1 GENERAL

A. Verify existing plant life designated to remain and tag as such.

B. Locate, identify and protect all utilities.

C. Locate, identify and protect bench marks and existing structures.

D. Maintain surface drainage on site during construction. Remove unsatisfactory fill material and waste vegetation from jobsite and dispose of properly.

3.2 PRESERVATION AND RESTORATION

A. Protect trees that are to remain in the project area or in adjacent areas. Take special care not to damage trees outside limits of construction.

B. Fill depressions made by grubbing with suitable material to make new surface conform to the existing adjacent ground surface.

C. Final Cleanup: Level washes, ruts, depressions, and mounds to give areas smooth finish.

3.3 CLEARING

A. Remove designated trees and shrubs along with stumps, roots, rubbish and other objectionable material from the designated areas.

B. Remove grass and weeds to a depth of two (2) inches below existing soil line.

C. Remove stumps, roots, muck and spongy materials within the area to a depth of eighteen (18) inches.

D. For areas where paving will be built remove stumps and roots within pavement section to depth of two feet below finish subgrade elevation.

E. Provide demolition as required and specified in Section 02115 and the Drawings.

3.4 REMOVING MATERIAL

A. Unless otherwise specified, cleared and grubbed material shall become property of the Contractor and be removed from the work site or disposed of in manner not to damage the Owner.

B. Burning of cleared and grubbed material on the Owner's property is not permitted.

END OF SECTION

SECTION 02281 - TERMITE CONTROL

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Provide soil treatment for termite control, as herein specified.

QUALITY ASSURANCE:

In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work, including preparation of substrate and application.

Engage professional pest control operator, licensed in accordance with regulations of governing authorities for application of soil treatment solution.

JOB CONDITIONS:

Restrictions: Do not apply soil treatment solution until excavating, filling and grading operations are completed, except as otherwise required in construction operations.

To insure penetration, do not apply soil treatment to frozen or excessively wet soils or during inclement weather. Comply with handling and application instructions of the soil treatment manufacturer.

SUBMITTALS:

Product Data: Submit manufacturer's technical data and application instructions.

SPECIFIC PRODUCT WARRANTY:

Furnish written warranty certifying that applied soil poisoning treatment will prevent infestation of subterranean termites and, that if subterranean termite activity is discovered during warranty period, Contractor will re -treat soil and repair or replace damage caused by termite infestation.

Provide warranty for a period of 5 years from date of treatment, signed by Applicator and Contractor. (Include in Project Close Out-Documents)

PART 2 – PRODUCTS

Talstar P Professional Insecticide

SOIL TREATMENT SOLUTION:

Use an emulsible concentrate insecticide for dilution with water, specially formulated to prevent infestation by termites. Fuel oil will not be permitted as a dilutant. Provide a solution consisting of one of the following chemical elements and concentrations:

Chloropyrifos (Dursban TC); 1.0% in water emulsion.

Permathrin (Dragnet, Torpedo); 0.5% in water emulsion.

Cypermethrin (Prevail FT); 0.25% in water emulsion.

PART 3 - EXECUTION

APPLICATION:

Surface Preparation: Remove foreign matter which could decrease effectiveness of treatment on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and foundations. Toxicant may be applied before placement of compacted fill under slabs, if recommended by toxicant manufacturer.

Application Rates: Apply soil treatment solution as follows:

Under slab on grade structures, treat soil before concrete slabs are placed using either power sprayer or tank -type garden sprayer.

Apply 4 gallons of chemical solution per 10 lineal feet to soil critical areas under slab, including entire inside perimeter inside of foundation walls, along both sides of interior partition walls, and around plumbing pipes and electric conduit penetrating slab, and around interior column footers.

Apply one gallon of chemical solution per 10 square feet as an overall treatment under slab and attached slab areas where fill is soil or unwashed gravel. Apply 1 -1/2 gallons of chemical solution to areas where fill is washed gravel or other coarse absorbent material.

Elsewhere: Apply uniformly under sidewalks and all other paved areas within five feet of building, at rate of one gallon per ten square feet.

At expansion joints, control joints, and areas where slabs will be penetrated, at rate of 4 gallons per 10 lineal feet of penetration.

Allow not less than 12 hours for drying after application, before beginning concrete placement or other construction activities.

Post signs in areas of application warning workers that soil poisoning has been applied. Remove signs when areas are covered by other construction.

Reapply soil treatment solution to areas disturbed by subsequent excavation or other construction activities following application.

END OF SECTION 02281

SECTION 02444 VINYL COATED CHAIN LINK FENCES AND GATES

PART 1 GENERAL

RELATED DOCUMENTS
Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

DESCRIPTION OF WORK:
Extent of vinyl coated chain link fences and gates is shown on drawings.

QUALITY ASSURANCE

Provide chain link fences and gates as complete units controlled by a single source including necessary erection accessories, fittings, and fastenings.

SUBMITTALS

Submit Product data in the form of manufacturer's technical data, specifications, and installation instructions for metal fencing and gates.

PART 2 PRODUCT

GENERAL

Exterior Chain Link Fence 7ft High Black Vinyl, and Black Vinyl Posts

Dimensions shown form pipe, roll formed, and H sections are outside dimensions.

MANUFACTURERS

Vinyl Coated Steel Fencing and Fabric:
Allied Tube and Conduit Corp.
Anchor Fence, Inc.
Colorguard Corp.
Davis Walker Corp.
Dominion Fence and Wire Prod.
United States Steel.

STEEL FENCING (STFN):
Fabric: No. 9 ga. (0.148") finished steel wires, 2" mesh, with top selvages knuckled for fabric 60" high and under, and both top and bottom selvages twisted and barbed for fabric over 60" high. Furnish one-piece fabric widths for fencing up to 12' high.

Fabric coating: The zinc coating of the fabric shall be minimum .30 oz./sq. ft. of uncoated wire surface. The weight of zinc coating on the fabric shall be determined in accordance with ASTM A-90.

PVC: Wire shall be coated with a minimum of 7 mils of poly-vinyl chloride permanently bonded to the galvanized wire by the thermal fusion bonded method. Chain link fabric shall conform to the requirements of ASTM F-668, class 2b.

HARDWARE AND ACCESSORIES:

Framework: Galvanized steel, ASTM A 120 or A 123, with not less than 2.0 oz. zinc per sq. ft. of surface. All framework and components shall be coated with 10 to 15 mils of PVC.

End, Corner, and Pull Posts: Minimum sizes and weights as follows:

Up to 6 feet fabric height: 2.375 inch OD steel pipe, 3.65 lbs. per lin. ft., or 3.5 inch by 3.5 inch roll formed sections weighing 4.85 lb. per lin. ft.

Over 6 feet fabric height: 2.875 inch OD steel pipe, 5.79 lbs. per lin. ft., or 3.5 inch by 3.5 inch roll formed sections weighing 4.85 lbs. per lin. ft.

Line posts Space 10' o.c. maximum, unless othewise indicated, of following minimum sizes and weights.

Up to 6 feet fabric height: 1.90 inch OD steel pipe, 2.70 lbs. per lin. ft. or 1.875" x 1.625" C sections, 228 lbs. per lin. ft.

6' to 8' fabric height, 2.375" OD steel pipe, 3.65 lbs. per lin. ft. or 2.25" x 1.875" H sections, 2.64 lbs. per lin. ft.

Over 8 feet fabric height: 2.875 inch OD steel pipe, 5.79 lbs. per lin. ft. or 2.25" x 1.875" H sections, 3.26 lbs. per lin. ft.

Gate Posts: Furnish posts for supporting single gate leaf, or one leaf of a double gate installation, for nominal gate widths as follows:

Leaf Width	Gate Post	Lbs./Lin. Ft.
Up to 6"	3.5" x 3.5" roll formed section or 2.875" OD pipe	4.85 5.79
Over 6' to 13'	4.000" OD pipe	9.11
Over 13' to 18'	6.625" OD pipe	18.97
Over 18'	8.625" OD pipe	28.55

Tension Wire: 7 gage, coated coil spring wire, metal finish to match fabric. Locate wire at bottom of fabric.

Top Rail: Provide 1 -5/8" diameter galvanized steel.

Post Brace Assembly: Manufacturer's standard adjustable brace at end and gate posts and at both sides of corner and pull posts, with horizontal brace located at mid height of fabric. Use same material as top rail for brace, and truss to line posts with 0.375"diameter rod and adjustable tightener.

Post Tops: Weathertight closure cap for tubular posts. Provide one cap for each post.

Stretcher Bars: One piece lengths equal to full height of fabric, with minimum cross section of 3/16" x 3/4". Provide one stretcher bar for each gate and end post, and two for each corner and pull post, except where fabric is integrally woven into post.

Corner Bracing: Install diagonal cross bracing consisting of 3/8" diameter adjustable

length truss rods on corner posts to ensure frame rigidity without sag or twist, if required.

Stretcher Bar Bands: Space not over 15" oc., to secure stretcher bars to end, corner, pull and gate posts.

GATES

Fabrication: Fabricate gate perimeter frames of 1.90" OD pipe.
Metal and finish to match fence framework. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware, and accessories. Space frame member's maximum of 8 feet apart.

Assemble gate frames by welding or with special fittings and rivets, for rigid connections. Use same fabric as for fence, unless otherwise indicated. Install fabric with stretcher bars at vertical edges. Bars may also be used at top and bottom edges. Attach stretchers to gate frame at not more than 15" o.c. Attach hardware to provide security against removal or breakage.

Install diagonal cross bracing consisting of 3/8" diameter adjustable length truss rods on gates to ensure frame rigidity without sag or twist, if required.

Gate Hardware: Furnish the following hardware and accessories for each gate.

Hinges: Size and material to suite gate size, non lift off type, offset to permit 180 deg gate opening. Provide 1 1/2 pair of hinges for each leaf over 6 foot nominal height.

Latch: Forked type or plunger bar type to permit operation from either side of gate, with padlock eye as integral part of latch.

Keeper: Provide keeper for vehicle gates, which automatically engages gate leaf and holds it in open position until manually released.

Sliding Gates: Provide manufacturer's standard heavy duty track, ball bearing hanger sheaves, overhead framing and supports, guides, stays, bracing, hardware, and accessories as required.

Wire Ties: For tying fabric to line posts, use wire ties spaced 12" o.c. For typing fabric to rails and braces, use wire ties spaced 24" o.c. For tying fabric to tension wire, use hog rings spaced 24" o.c.

Manufacturer's standard procedure will be accepted if of equal strength and durability.

Concrete: Provide concrete consisting of Portland cement, ASTM C150, aggregates, ASTM C33, and clean water. Mix materials to obtain concrete with a minimum 28 day compressive strength of 2500 psi using at least 4 sacks of cement per cu. yd., 1" maximum size aggregate, maximum 3" slump, and 2% to 4% entrained air.

PART 3 EXECUTION

INSTALLATION

Do not begin installation and erection before final grading is completed, unless otherwise permitted.

Excavation: Drill holes for posts to diameters and spacings shown, in firm, undisturbed or compacted soil.

If not shown on drawings, excavate holes for each post to minimum diameter recommended by fence manufacturer.

Unless otherwise indicated, excavate hole depths approximately 3 inches lower than post bottom, with bottom of posts set not less than 36 inches below finish grade surface.

Setting Posts: Center and align posts in holes 3 inches above bottom of excavation.

Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.

Center Rails: Provide center rails where shown. Install in one piece between posts and flush with post on fabric side, using special offset fittings where necessary.

Brace Assemblies: Install braces so posts are plumb when diagonal rod is under proper tension.

Tension Wire: Install tension wires before stretching fabric and tie to each post with not less than 6 ga. galvanized wire. Fasten fabric to tension wire using 11 gage galvanized steel hog rings of spaced 24 inches o.c.

Fabric: Leave approximately 2 inches between finish grade and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, and anchor to framework so that fabric remains in tension after pulling force is released.

Stretcher Bars: Thread through or clamp to fabric 4 inches o.c., and secure to posts with metal bands spaced 15 inches o.c.

Gates: Install gates plumb, level, and secure for full opening without interference. Install ground set items in concrete for anchorage as recommended by manufacturer. Adjust hardware for smooth operation and lubricate where necessary.

Tie Wires: Use U shaped wire, conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least 2 full turns. Bend wire to minimize hazard to persons or clothing.

Fasteners: Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

END OF SECTION 02444

SECTION 02810 – IRRIGATION

PART 1 - GENERAL

1.01 SCOPE

A. An automatic underground irrigation system for exterior landscaped areas including, but not limited to, supply an installation of water meter, backflow device and controller, boring and sleeving, rotary heads and spray heads in lawn areas and spray heads and drip lines in shrub, ground cover, and flower bed areas.

1.02 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Provide connection to water source (existing mainline) and new water meters as specified and in accordance with local code requirements.
   2. Provide for an electro-mechanical controller.

B. Performance Requirements: Provide for irrigation at a rate of 1 in. per week applied at 2 or 3 day intervals.

1.03 QUALIFICATIONS

A. Irrigation work to be performed by a Texas licensed irrigation company specializing in commercial irrigation installation with a minimum of five (5) years experience on similar projects. Owner/SSP Design to review qualifications and approve subcontractor prior to commencing work.

1.04 SUBMITTALS

A. Submittals shall be formatted electronically in a PDF file with a table of contents and tabs identifying each section. The following submittals are required for this section:
   1. Product Data: Manufacturers' technical data (Cut Sheets) and installation information for all components including: Backflow Assembly (Pressure Vacuum Breaker PVB or Reduced Pressure, Backflow Preventer RPZ (as specified), Y strainer (if required), Ball valves, PVC pipe, PVC fittings, PVC primers, solvents, cement, glue, etc., Control wire / tracking wire, Wire connectors, Pump stations, booster pumps (if specified), Pump enclosures (if specified), Controller (incl. communications modules, etc.), Rain/freeze sensors, Valves, Valve boxes, Decoders (if specified), Rotors, Sprays, Nozzles, Bubblers, Drip line, Drip filters, Drip indicators (operind), Air relief valves

1.05 QUALITY CONTROL

A. Submit verification of water pressure at meter or point of connection.

1.06 MAINTENANCE/WARRANTY

A. Provide the following extra materials to the Owner:
   1. Two (2) quick coupler hose bib keys.
   2. Four (4) keys for the controller door lock.

B. Maintenance Requirements: Maintain the work of this Section for ninety days after ‘substantial completion’ and until final acceptance by Owner. Notify the owner in writing of ‘substantial completion’. Maintenance period begins after owner’s acceptance of ‘substantial completion’.

C. Maintenance Service: Perform the following maintenance operations at least once a week:

a. Test entire system and adjust timer as necessary and as directed by landscape contractor, landscape designer or owner.
b. Replace or repair any broken parts or equipment.
c. Report any significant problems in writing to landscape contractor, owner and landscape designer.

D. Warranty: Warranty shall cover all parts and equipment for a period of one year from the date of final acceptance. Repairs and replacements shall be completed within two weeks of notification from owner.

PART 2 PRODUCTS

2.01 MATERIALS

A. PVC Plastic Pipe: ASTM D 2241-83, SDR21, class 160 lateral piping; ASTM D1785, class 200 mainline piping.

B. Pipe Fittings:
1. Pipe under 3 in., id: Socket type, ASTM D 2466-78, with solvent Cement, ASTM D 2564-80.
2. Pipe 3 in. id and Larger: Gasketed fittings of epoxy coated steel with non-hardening pipe dope or Teflon tape for threads.

C. Concrete: 2500 psi min. compressive strength.

2.02 MANUFACTURED UNITS

A. Controller: Electro-mechanical, 24 hr./14-day clock with manual operation capacity, with adequate number of stations for system operating requirements (two wire) (see irrigation equipment table). Provide both freeze-protection and rain-sensor devices with controller. Provide ground-fault interrupt and lightning protection. Provide flow control, ET Management, and IQ System.

B. Water Meters: Water meters in locations shown on plans. Contractor to coordinate application, permit and installation with local utility company. Contractor responsible for water meters and all associated installation costs.

C. Booster Pump: This project has an existing booster pump that the contractor shall remove and return to the Owner. The contractor shall furnish and install a new booster pump as specified in plans/details. Contractor shall also provide a concrete pad and any and all fittings, adaptors, connections, etc. for the complete installation and proper operation of the new booster pump.

D. Backflow Preventers: Provide and install backflow devices per local codes, specifications and requirements.

E. Electric Valves: Normally closed, 24v AC, 60 cycle, solenoid actuated, globe pattern, diaphragm type. Cast brass or plastic body and nylon reinforced nitrile rubber diaphragm.

F. Quick coupling Valves: Cast brass body with self-closing cover. Provide (2) brass keys with 1 in. female threaded outlet.

G. Sprinkler Heads: Heavy-duty plastic sprinkler case, high density plastic sprinkler body, corrosion-resistant internal parts, plastic spray nozzles with adjustable flow and direction features.

H. Control Wire: 24v UL/UF., approved for direct burial. Provide color-coded wire with white used for common (14-gauge, single-strand copper) and red for control (14-gauge single-strand copper).

I. Tracking Wire: 18 gauge copper (only where mainline and wiring bundle are separated)

J. Valve Boxes: Heavy-duty commercial grade, fiberglass reinforced, plastic with locking covers. Rainbird VB series, 10" Round or Standard Rectangular Min. or apprvd equal.

K. Swing Joints: 3 high density polyethylene street ells with 8 in. Schedule 80 PVC nipple; sized the same as inlet to sprinkler head.

L. Sleeves: Schedule 40 PVC. Boring as required under all existing pavement, walls or curbs.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Examine the site and conditions under which irrigation work is to be performed. Irrigation contractor shall notify the landscape contractor in writing, with a copy to Construction Manager, if the site is unsatisfactory. Do not begin the work until unsatisfactory conditions have been corrected in a manner acceptable to irrigation contractor. Beginning of work indicates acceptance of the site as satisfactory by the irrigation contractor.

3.02 INSTALLATION

A. General: Install tracking wire along mainline pipe if separate from valve wiring bundle.

B. Excavating and Filling:
   1. Cover for Piping:
      a) Mains: 18 in. min.
      b) Laterals: 12 in. min.
   2. Use clean backfill material without stones larger than 1/2 in., debris or extraneous material that may damage pipe assembly.
   3. Compact all trenches to a minimum 95% Standard Proctor Density.

C. Pipe:
   1. Install in existing sleeves under pavement or provide boring and sleeves under pavement as required.
   2. Clean pipe and joints before making connections. Purple primer to be used on all joints before applying solvent. Per TCEQ Regulations.
   3. Attach joints according to manufacturer's instructions. Threaded joints to be coated with "Teflon" tape. Allow joints to set for at least 24 hrs. before applying water pressure to the system.
   4. Thoroughly flush piping before sprinkler heads are installed and test under pressure for leaks in each line separated by valves.

D. Water Meters: Provide and install water meters per local codes, specifications and requirements. Coordinate permit and application with owner and local utility company. Adjust locations as necessary to coordinate with existing water line locations.

E. Back Flow Protection: Provide and install backflow devices per local codes, specifications and requirements.

F. Valves:
1. Provide isolation valve on inlet side of every electric control valve (if specified).

Install electric and gate valves with at lest 10 in. of cover over the valve and at least 6 in. of cover over the stem.

Install valve box centered over the flow control handle. Provide 1 cu. ft. of clean pea gravel in the bottom of each valve box with filter fabric below.

G. Controllers: Hard wire to nearest power source. Coordinate with general contractor. Install on exterior wall in location as directed/approved by SSP.

H. Sprinkler Heads: Install all heads on swing joint assemblies and flush with finish grade.

I. Wiring:
1. Bundle and tape wires at 10 ft. o.c., max.
2. Snake wire in trenches to allow for expansion. Provide expansion coils at 100 ft. o.c. max., and at the entry to each valve box.
3. Splice wires using mechanical sealant connector for a waterproof connection. Make all wire splices within valve boxes.

3.03 FIELD QUALITY WORK

A. General: Notify the Construction Manager at least 48 hours before testing is begun.
B. Hydrostatic Test: Test mainline piping to a hydrostatic pressure of not less than 100 psi. Piping may be tested in sections to expedite work. Remove and repair piping and connections which do not pass hydrostatic testing.
C. Operational Testing: Perform operational testing after hydrostatic testing is completed, backfill is in place, and sprinkler heads adjusted to final position.

3.04 ADJUSTING

A. Check sprinkler heads for arc of spray. Adjust as necessary to provide 100% coverage of all landscaped areas.
B. Adjust layout to conform to actual layout of landscape plantings.

3.05 DEMONSTRATION

A. Demonstrate operation of the system to Owner's personnel and staff.

3.06 CLOSE-OUT DOCUMENTS

A. As-Built Drawings: Submit ‘As-Built’ drawings before project close-out showing the irrigation system layout, including line locations and sizes, spray heads and types, points of connection, booster pump, location of backflow device(s), controller, and other installation information.
B. Warranty Letters: Submit warranty letters for all irrigation items including labor for the specified warranty period.

C. Operation and Maintenance Data: Submit Manufacturers' operation and maintenance instructions and laminated colored (11x17) valve Zoning Diagram.

END OF SECTION

SECTION 02825 - ORNAMENTAL FENCES AND GATES

2.01 MANUFACTURER:

The fencing system shall be Industrial Aluminum Fence #202 Series as manufactured by Jerith Manufacturing Co., Inc., 14400 McNulty Road, Philadelphia, PA 19154. (Telephone: 800-344-2242; Fax: 215-676-9756; email: sales@jerith.com.)

Elite Fence Products, Inc., 835 Scott St, Murfreesboro, TN 37129; (615) 849-1886, Industrial EFF-20 is an approved manufacturer.

Ameristar Fence Products, 1555 N. Mingo Rd., Tulsa, OK 74116; (888) 333-3422, Echelon II 3-Rail Profile is an approved manufacturer.

2.02 MATERIALS:

A. Aluminum Extrusions: All posts and rails used in the fence system shall be extruded from HS-35™ aluminum alloy having minimum yield strength of 35,000 psi. All pickets shall have minimum yield strength of 25,000 psi. 6063-T5 Alloy is not acceptable for any components.

B. Fasteners: All fasteners shall be stainless steel. Square drive screws shall be used to connect the pickets to the horizontal rails. Rail to post connections shall be made using self-drilling hex-head screws.

C. Accessories: Aluminum sand and die castings shall be used for all scrolls, post caps, finials, and miscellaneous hardware. Die castings shall be made from Alloy 360.0 for superior corrosion resistance. Alloy 380.0 is not acceptable.

2.03 FINISH:

A. Pretreatment: A three stage non-chrome pretreatment shall be applied. The first step shall be a chemical cleaning, followed by a water rinse. The final stage shall be a dry-in-place activator which produces a uniform chemical conversion coating for superior adhesion.

B. Coating: Fence materials shall be coated with FencCoat™, a Super-Durable TGIC polyester powder-coat finish system applied by Jerith Manufacturing Company. Epoxy powder coatings, baked enamel or acrylic paint finishes are not acceptable. The FencCoat finish shall have a cured film thickness of at least 2.0 mils. In addition, the screw heads shall be painted to match the color of the fence. The color of the fence system shall be selected from standard colors.

C. Tests: The cured FencCoat finish shall meet AAMA 2604 “Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels”, which includes the following requirements:

1. Humidity resistance of 3,000 hours using ASTM D2247.
2. Salt-spray resistance of 3,000 hours using ASTM B117.
3. Outdoor weathering shall show no adhesion loss, checking or crazing, with only slight fade and chalk when exposed for 5 years in Florida facing south at a 45 degree angle.

Finishes which only meet AAMA 2603 (or the previous version - AAMA 603) are not acceptable.

2.04 CONSTRUCTION:

A. Horizontal rails shall be 1 5/8” x 1 5/8” channels formed in a modified “U” shape. Pickets shall pass through holes punched in the top of the rail. The top wall shall be

.072” thick and the side walls .082” thick for superior vertical load strength. There shall be 3 horizontal rails in each section.

B. Pickets shall be fastened to the rails using painted stainless steel screws. Screws shall be used on only one side of the rail, leaving the other side with a clean appearance. Pickets shall be 1” square and have a wall thickness of .062”. Welding the pickets to the rails is not permitted.

C. Posts shall be 2 1/2” square extrusions with pre-punched holes which allow the fence section rails to slide in. Posts shall be spaced 72” on center and have .075 walls. Gate posts shall be 4” square with .125” walls and used on both sides of a gate. Die cast aluminum caps shall be provided with all posts.

D. Gates shall have welded frames and shall support a 250 lb. vertical load on the latch side of the gate without collapsing. Walk gates shall be self-closing and self-latching.

E. Assembled sections shall support a 1,000 lb. vertical load at the midpoint of any horizontal rail.

2.05 ADDITIONAL GATE HARDWARE:

Provide Panic Hardware equal to DAC Industries, Inc.(800.888-9768), Model 6045 Superior Exit Bar Kit with Lockey Model 115p Keypad Lockset.

2.06 WARRANTY:

The entire fence system shall have a written Limited Lifetime Warranty against rust and defects in workmanship and materials. In addition, the FencCoat finish shall be warranted not to crack, chip, peel, or blister for the same period.

PART 3 - EXECUTION

Installation: All material must be checked upon receipt at the job site prior to installation to check for any damage that may have occurred during transport. The fence system must be stored in a safe and dry environment so as to protect if from any potential damage. This aluminum Ornamental Fence system must be installed in accordance with manufacturer’s standard procedures.

END OF SECTION 02825

Section - 02829 Slide Gate Operator

PART I – GENERAL

1.01. INCLUDED IN THIS SECTION
- A. Pre-wired, self-contained, slide gate operator for horizontal sliding gates, including all selected attachments and accessory equipment.
- B. For further information, call the factory at (800) 321-9947.

1.02. RELATED WORK SPECIFIED ELSEWHERE
- A. Fencing: See section 02815.
- B. Cast in place concrete: See section 03010.
- C. Electrical service and connections: See Electrical.

1.03. SUBMITTALS
- A. Shop drawings: Submit shop drawings under the provisions of Section 01300. Submit drawings showing connections to adjacent construction, range of travel, and all electrical and mechanical connections to the operator. Drawings shall also show the size and location of the concrete mounting pad. Underground electrical runs and inductive vehicle obstruction loop locations shall be shown on shop drawings.
- B. Installation instructions: Submit two copies of manufacturer's installation instructions for this specific project.
- C. Test reports:
  - a) Submit affidavits from the manufacturer demonstrating that the gate mechanism has been tested to 200,000 cycles without breakdown.
  - b) Each operator shall bear a label indicating that the operator mechanism has been tested for full power and pressure of all hydraulic components, full stress tests of all mechanical components and electrical tests of all overload devices.

1.04. QUALITY ASSURANCE
- A. Manufacturer: A company specializing in the manufacture of hydraulic gate operators of the type specified, with a minimum of ten years experience.
- B. Installer: A minimum of three years experience installing similar equipment, provide proof of attending a HySecurity factory technical training within previous three years, or obtain other significant manufacturer endorsement of technical aptitude, if required, during the submittal process.

1.05. CODES AND REGULATORY REQUIREMENTS
- A. Operators shall be built to UL 325 standards and be listed by a testing laboratory. Complete all electrical work according to local codes and National Electrical Code. All fieldwork shall be performed in a neat and professional manner, completed to journeyman standards.
- B. Current safety standards require the use of multiple external sensors to be capable of reversing the gate in either direction upon sensing an obstruction. See also 2.02D.
  - a) Vehicle gates should never be used by pedestrians. Separate pedestrian gates must always be provided when foot traffic is present.
  - b) Current safety standards require gate operators to be designed and labeled for specific usage classes. HySecurity Model SlideDriver 15 UPS (222 DS ST) is listed for use in all UL 325 Usage Classes: I, II, III, and IV.

1.06. PRODUCT DELIVERY AND STORAGE

A. Comply with 01600.

B. Store products upright in the original shipping containers, covered, ventilated and protected from all weather conditions.

1.07. WARRANTY

A. Provide a five-year limited warranty against all defects in materials or workmanship; except batteries, which are covered under a one-year warranty. Defective materials shall be replaced with comparable materials furnished by the manufacturer, at no cost to the owner. Freight, labor and other incidental costs are not covered under the factory warranty, but may be covered by a separate service agreement between installing company and the owner.

a) To ensure validation of warranty, return completed warranty registration form (included in Installation and Reference manual) to manufacturer.

PART II – PRODUCTS

2.01. GATE OPERATORS

A. HySecurity gate operator model SlideDriver 15 UPS (222 DS ST) with Smart Touch Controller, or other comparable operator, as approved by the architect or specifier. Substitute operators that are approved will be published in an addendum, not less than ten days prior to bid opening. Requests for substitution will include the amount of savings to be passed on to the owner.

2.02. OPERATION

A. Operation shall be by means of a metal rail passing between a pair of solid metal wheels with polyurethane treads. Operator motors shall be hydraulic, geroller type, and system shall not include belts, gears, pulleys, roller chains or sprockets to transfer power from operator to gate panel. The operator shall generate a minimum horizontal pull of 300 (136 kg) pounds without the drive wheels slipping and without distortion of supporting arms. Operator shall be capable of handling gates weighing up to 1500 pounds (680 kg). Gate panel velocity shall not be less than 1.0 feet (.30 m) per second and shall be stopped gradually to prevent shock loads to the gate and operator assembly

B. Standard mechanical components shall include as a minimum:

1. Supporting arms: Cast aluminum channel. Arms shall incorporate a fully bushed, 1-1/2" (38 mm) bronze bearing surface, acting on arm pivot pins. (item 2 below)
2. Arm pivot pins: 3/4" (19 mm) diameter, stainless steel, with integral tabs for ease of removal.
3. Tension spring: 2-1/2" (63.5 mm) heavy duty, 800 pound (363 kg) capacity.
4. Tension adjustment: Finger tightened nut, not requiring the use of tools.
5. Drive release: Must instantly release tension on both drive wheels, and disengage them from contact with drive rail in a single motion, for manual operation.
6. Limit switches: Fully adjustable, toggle types, with plug connection to control panel.
7. Electrical enclosure: Oversized, metal, with hinged lid gasketed for protection from intrusion of foreign objects, and providing ample space for the addition of accessories.

8. Chassis: 1/4" (6.35 mm) steel base plate, and 12 Ga. (2.66 mm) sides and back welded and ground smooth.
9. Cover: 16 Ga. (1.52 mm) zinc plated steel with textured TGIC polyester powder coat finish. All joints welded.
10. Finish: Zinc plated steel with textured TGIC polyester powder coat finish, proven to withstand 1000-hour salt spray test.
11. Drive wheels: Two 6" (152 mm) Dia. metal hub with polyurethane tread.
12. Drive rail: Shall be extruded 6061 T6, not less than 1/8" (3.175 mm) thick. Drive rail shall incorporate alignment pins for ease of replacement or splicing. Pins shall enable a perfect butt splice.
13. Hydraulic hose: Shall be 1/4" (6.35 mm) synthetic, rated to 2750 PSI (19 MPa).
14. Hydraulic valves: Shall be individually replaceable cartridge type, in an integrated hydraulic manifold.
15. Hose fittings: At manifold shall be quick-disconnect type, others shall be swivel type.
16. Hydraulic fluid: High performance type with a viscosity index greater than 375 and temperature range -40F to 167F (-40C to 75C) degrees.
17. A zero to 2000 PSI (14 MPa) pressure gauge, mounted on the manifold for diagnostics, shall be a standard component.
18. The hydraulic fluid reservoir shall be formed from a single piece of metal, non-welded, and shall be powder painted on the inside and the outside, to prevent fluid contamination.

C. Minimum standard electrical components:
1. Pump motor: Shall be minimum 2 HP, 56C, 24 V DC motor.
2. All components shall have overload protection.
3. Controls: Smart Touch Controller Board with 256K or program memory containing:
   a) inherent entrapment sensor;
   b) built in “warn before operate” system;
   c) built in timer to close;
   d) liquid crystal display for reporting of functions;
   e) 26 programmable output relay options;
   f) anti-tailgate mode;
   g) built-in power surge/lightning strike protection;
   h) menu configuration, event logging and system diagnostics easily accessible with a PC and HySecurity’s free START software;
   i) RS232 port for connection to laptop or other computer peripheral and RS485 connection of Master/Slave systems or network interface.
4. Low voltage sensor to protect batteries from over discharge. Last operation can be programmed for fail secure or fail open
5. AC power loss operation: the operation can be programmed to open immediately or stay open after next normal operation, or remain in normal operation until batteries are low.
6. Control circuit: 24VDC.
7. Permanently sealed, maintenance free, lead acid batteries in separate insulated and ventilated enclosure.
8. Battery enclosure is NEMA 3R, pre-galvanized and painted dark gray enamel.
9. 20 amp, fully automatic, regulated battery charger,

D. Required external sensors: See 1.05B. Specify photo eyes or gate edges or a combination thereof to be installed such that the gate is capable of reversing in either direction upon sensing an obstruction.

E. Optional control devices: pushbuttons, vehicle detectors, keypads and seven day timers.
F. Other options
    1. Lock for operator cover.
    2. Electric Solenoid gate panel deadbolt lock.
    3. Drive wheel manual release indicator switch.
    4. Heater with thermostat control for cold or damp climates.
    5. Weather-stripped drive rail slot in chassis, and snow wiper blades for drive rail.
    6. Gate edge and transmitter radio reversing device.
    7. HY-5A plug in loop detectors.
    8. Key operated cable manual release (secure side of gate).
    9. Pneumatic remote gate release devices. Places operator in "manual mode" from remote location (lockable box on public side of gate).
    10. HySecurity factory drive rail.
    11. XtremeDrive System
    12. 115/208/230 VAC single phase only. (50 Hertz is available by custom order)
    13. Hot dip galvanized chassis and cover, unpainted, for marine, caustic, or other extreme environments.
    14. Knox Box for Fire Marshall Access at each operator.

2.03. FACTORY TESTING
A. Fully assemble and test, at the factory, each gate operator to assure smooth operation, sequencing and electrical connection integrity. Apply physical loads to the operator to simulate field conditions. Tests shall simulate physical and electrical loads equal to the fully rated capacity of the operator components.
B. Check all mechanical connections for tightness and alignment. Check all welds for completeness and continuity. Check welded corners and edges to assure they are square and straight.
C. Inspect painted finish for completeness. Touch up imperfections prior to shipment.
D. Check all hydraulic hoses and electrical wires to assure that chafing cannot occur during shipping or operation.

PART III – EXECUTION

3.01. SITE EXAMINATION
A. Locate concrete mounting pad in accordance with approved shop drawings.
B. Make sure that gate is operating smoothly under manual conditions before installation of gate operators. Do not proceed until gate panel is aligned and operates without binding.

3.02. INSTALLATION
A. Install gate operator in accordance with the manufacturer's printed instructions, current at the time of installation. Coordinate locations of operators with contract drawings, other trades and shop drawings.
B. Installer shall insure that the electric service to the operator is at least 20 AMPS. Operator wattage is 1000.

3.03. FIELD QUALITY CONTROL
A. Test gate operator through ten full cycles and adjust for operation without

binding, scraping or uneven motion. Test limit switches for proper "at rest" gate position.

B. All anchor bolts shall be fully concealed in the finished installation.

C. Owner, or owner’s representative, shall complete “punch list” with installing contractor prior to final acceptance of the installation and submit completed warranty documentation to manufacturer.

3.04. CONTINUED SERVICE AND DOCUMENTATION

A. Train owner's personnel on how to safely shut off electrical power, release and manually operate the gate. Additionally, demonstrate the general maintenance of the gate operator and accessories and provide one copy of "Installation and Reference" manual for the owner's use (a second manual is available upon request). Manuals will identify parts of the equipment for future procurement. Direct maintenance personnel to HySecurity’s website, specifically the technical support sections.

SECTION 02900 – PLANTING

PART 1 GENERAL

1.01 SCOPE

A. Supply and installation of all approved materials, labor, equipment, transportation and services required and incidental thereto, in conformity with the plans and specifications, including but not limited to; vegetation protection/pruning, fine grading, earth mounding, bed excavation and preparation, bed edging, planting soil/compost mixes, fertilizer, mulch, trees, palms, shrubs, ground covers, staking, paving, site furniture, clean-up, maintenance, and warranty.

B. Related Sections:
   1. Irrigation – 02810
   2. Lawns – 02930

1.02 REFERENCE STANDARDS

A. General: "Hortus Third," 1976.

B. Texas Association of Nurserymen, Grades and Standards for Nursery Stock.

C. Plant Material: "American Standard for Nursery Stock," ANSI Z60.1-1990.

D. National Arborist Association Standards

1.03 DEFINITIONS

A. Specimen Plants: Plants having exceptional character, superiority in form and branching, and the best attributes of the species; all as determined by the Architect, Landscape Designer or Owner.

1.04 QUALIFICATIONS

A. Landscape work to be performed by a single firm specializing in commercial landscape work with a minimum of five (5) years experience on similar type projects. Owner/SSP Design to review qualifications and approve subcontractor prior to commencing work.

1.04 SUBMITTALS

A. Submittals shall be formatted electronically in a pdf file with a table of contents and tabs identifying each section. The following submittals are required for this section:
   1. Landscape Construction Sequence
   2. Edging Materials
   3. Post emergent Herbicides
   4. Pre emergent Herbicides
   5. Topsoil, Silica Sand, Compost and Mulch
   6. Sources of all Plant Materials (including address and telephone numbers)
   7. Product Data Material Safety Data Sheets
   8. Paving Materials
   9. Staking Materials
   10. Samples: One foot sections of edging (as specified on plans), one pound bag sample

of each; topsoil, silica sand, premium compost, mulch, decomposed granite, river rock, washed gravel and example boulder/rocks if specified.

11. Photographs of all plant material prior to ordering/installation
12. Name and License Number of Subcontractor for pruning trees (Certified I.S.A. Arborist required)

1.05 PROTECTION

A. Before commencing work, contractor shall place orange construction fencing around all vegetation labeled “to remain” on landscape plans. Fencing shall be placed squarely around each tree 6’ x 6’ and at least 60” in height or continuously around groups of vegetation as shown on plans. No work may begin until this requirement is fulfilled. All other vegetation not labeled “to remain” shall be cleared and grubbed including root systems.

B. In order to avoid damage to roots, bark or lower branches, no truck or other equipment shall be driven or parked within the drip line of any tree, unless the tree overspreads a paved way.

C. The contractor shall use any and all precautionary measure when performing work around trees, walks, pavements, utilities, and any other features either existing or previously installed under this Contract.

D. The Contractor shall adjust depth of earthwork and loaming when working immediately adjacent to any of the aforementioned features in order to prevent disturbing tree roots, undermining walks and pavements, and damage in general to any existing or newly incorporated item.

E. Where excavating, fill or grading is required within the branch spread of trees that are to remain, the work shall be performed as follows:

a. TRENCHING: When trenching occurs around trees to remain, the tree roots shall not be cut but the trench shall be tunneled under or around the roots by careful hand digging and without injury to the roots.

b. RAISING GRADES: When the existing grade at tree is below the now finished grade, and fill not exceeding 16 inches (16") is required, clean, washed gravel graded from one to two inches (1" - 2") in size shall be placed directly around the tree trunk. The gravel shall extend out from trunk on all sides a minimum of 18 inches (18") and finish approximately two inches (2") above the finished grade at tree. Install gravel before any earth fill is placed. New earth fill shall not be left in contact with the trunks of any trees requiring fill. Where fill exceeding 16 inches (16") is required, a dry laid tree well shall be constructed around the trunk of the tree. The tree well shall extend out from the trunk on all sides a minimum of three feet (3') and to three inches (3") above finish grade. Coarse grade rock shall be placed directly around the tree well extending out the drip line of the tree. Clean, washed gravel graded from one to two inches (1" - 2") in size shall be placed directly over the coarse rock to a depth of three inches (3"). Approved backfill material shall be placed directly over the washed gravel to desired finished grade.

c. LOWERING GRADES: Existing trees in areas where the now finished grade is to be lowered shall have regarding work done by hand to elevation as indicated. Roots as required shall be cut cleanly three inches (3") below finished grade and scars covered with tree paint.

d. Trees marked for preservation that are located more than six inches (6") above proposed grades shall stand on broad rounded mounds and be graded smoothly into the lower level. Trees located more than 16 inches (16") above proposed grades shall have a dry laid stonewall, or other retaining structure as detailed on the plans, constructed a minimum of five feet (5') from the trunk. Exposed or broken roots shall be cut clean and covered with topsoil.

F. Contractor is responsible for all protection measures listed above. If these procedures are not followed, contractor is responsible for replacement of existing trees with approved trees of equal caliper and height.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Transport plant materials covered or in closed vehicles to protect from exposure to heat and wind. Spray trees and in full leaf with anti-desiccant - as recommended by the manufacturer - before shipping. Take precautions to protect plant materials from desiccation and from damage to bark, branches and roots. Do not allow root balls to crack. Schedule shipments to coincide with planting work schedule.

B. Storage and Protection: If planting is delayed after delivery, keep plants in a shaded area, cover roots with mulch or topsoil, and keep plants constantly watered until planted.

1.07 MAINTENANCE/WARRANTY

A. Maintenance Requirements: Maintain the work of this Section throughout construction and for ninety days after 'substantial completion' and until final written acceptance by Owner. Notify the owner in writing of 'substantial completion'. Maintenance period begins after owner's written acceptance of 'substantial completion'.

B. Maintenance Service: Perform the following maintenance operations at least once a week:
   1. Remove and replace dead plant material. Prune plants to remove dead wood and to maintain health of plants.
   2. Maintain all mulched areas at a 2 in. depth. Remove weeds and grass from shrub and ground cover areas and from watering basins.
   3. Provide insect and disease control to maintain health of plants.
   4. Irrigation:
      a) If the irrigation system is operating, program and monitor the system to provide adequate water for plants.
      b) If the irrigation system is not operating, hand water plants. Deep water trees each week.
   5. Dispose of all maintenance debris/clippings off-site. Owner's dumpsters shall not be used.
   6. Keep all site areas tidy and free of grass clippings, mulch or other foreign materials.
   7. Submit dates, descriptions and receipts of all maintenance operations to SSP Design for approval.

C. Warranty: Warranty shall cover all shrubs/groundcovers for a period of three months and trees/palms for a period of one year from the date of final acceptance. Any plant material deemed dead or unrecoverable by the owner shall be replaced with similar species and size within two weeks of notification from owner.

1.08 RIGHT OF REJECTION

A. The Owner/SSP Design reserve the right to inspect and reject plants at any time and at any place.

PART 2 PRODUCTS

2.01 MATERIALS

A. Fertilizer: 13-13-13 Osmocote slow release fertilizer granules or approved equal.

B. Planting tablets: Agraform 21 gram slow release fertilizer tablets or approved equal.

C. Compost: Premium grade compost ('9 Kids Compost' or approved equal).

D. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; minimum pH value of 5.4 and maximum 7.0; organic matter to exceed 1.5%, magnesium to exceed 100 units; phosphorus to exceed 150 units; potassium to exceed 120 units; soluble salts/conductivity not to exceed 900 ppm/0.9 mmhos/cm in soil.

E. Sand: For athletic fields. Silica sand, clean, screened and free of debris. (Mathis Sand, Wright Materials Plant-1, Tel. (361) 387-0293 or approved equal).

F. Mulch:
   1. Shrub and Ground Cover Planting Areas: Grade Grade A Shredded Hardwood; long, fibrous bark strands free from wood chips. Texas Natives or Approved Equal.
   2. Watering basins: Grade A Shredded Hardwood; long, fibrous bark strands free from wood chips. Texas Natives or Approved Equal.

G. Plants:
   3. General: Provide plant materials that are healthy and free from disease, insects, and larvae and without damage to bark, branches, and roots.
   4. Approval: All plants must be approved by Owner/SSP Design prior to installation. Any plants not approved by Owner/SSP Design shall be subject to rejection. All trees/palms must be inspected, approved and tagged by Owner/SSP Design at their place of origin or as directed in writing by Owner/SSP Design. Container grown trees shall be obtained by Glen Flora Farms, Inc. or approved equal.
   5. Sizes: Measured after pruning and in accordance with the plant schedule.
   6. Root Treatment: As follows in accordance with the Reference Standards:
      i. Palms: Balled and burlapped or containerized if they have been in the container for at least one growing season.
      ii. Trees, Shrubs, Ground Cover Plants: Container grown with a well-established fibrous root system.
   7. Palms: All new palms shall be field dug or containerized material in specified sizes shown in plant schedule. All palms shall have good form (straight trunks) consistent of its species, free of scares/abrasions/burn marks and disease and insects, with large healthy root systems. Rootballs sizes for B/B material must meet the following minimum specifications:
      a) Sabal Palms - 44" diameter, 36" height

b) Washingtonia Palms - 44” diameter, 36” height
c) Cuban Royal Palms, Mediterranean Fan Palms, Cocos Palms - 30” diameter, 30” height

H. Staking material:
1. Trees - Stakes shall be commercial grade T-Posts, 1.25 Gauge, 8’ Ht., Green with orange safety caps on tops. Note: Do not drive through stakes through root balls. Tree ties shall be Poly Chain Lock – 1” width, black, ProLock or approved equal
2. Palms – Treated pine lumber (2x4s) with reinforced metal strap ties per details
3. Shrubs – Use T-Posts and poly chain per above as necessary to hold upright any large or weak stemmed shrubs

I. Edging:
1. Concrete Edging: Extruded, colored, fibermesh reinforced concrete edging (per details) *Curb Appeal (or approved equal)*
2. Tree Rings: 4” Ht., 30” Dia., Black Anodized Aluminum tree rings. *Dreamscapes (or approved equal)*
3. Aluminum edging: 4” Ht., Black Anodized Aluminum Edging. *Dreamscapes (or approved equal)*

2.02 PLANTING SOILS

A. Planting Mix: 75 percent sandy-loam topsoil; 25 percent premium compost; (3:1 ratio by volume); and specified fertilizer or planting tablets.

B. Shrub and Ground Cover Areas:
1. Where topsoil has been installed: Apply one inch layer in planting bed; till into the top six inches of soil.
2. Where no topsoil has been installed: Remove twelve inches of existing soil and replace with ten inches of ‘Planting Mix’ as described in Item A above.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Examine the site and conditions under which landscape work is to be performed. Have the installer notify the Contractor in writing, with a copy to SSP Design if the site is unsatisfactory. Do not begin the work until unsatisfactory conditions have been corrected in a manner acceptable to installer. Beginning of work indicates acceptance of the site as satisfactory by the installer.

3.02 EXECUTION

A. Site Preparation: Contractors must visit and review site prior to bidding. Compacted soils and sub-soils from construction activities must be ripped and tilled until a loose, friable and free-draining condition is met. All existing weeds, grass, stabilized sub-base material, rubble, excavated soil and other material shall be removed from the site and disposed of by the contractor prior to starting any new landscape work. Soil conditions around entire site must be approved by Owner/SSP Design prior to rough and finished grading operations. Contractor shall not install any fill or topsoil in landscape areas prior to site condition approval by Owner/SSP Design.

B. Drainage: Landscape contractor shall follow grading as shown and specified on Civil Engineer's grading plans. Landscape contractor shall coordinate grading operations with site contractor. Landscape contractor shall ensure final grades conform to the Civil Engineer's grading plan including grades around building, swales, sidewalk under-drains/swales, roof drains, splash blocks and rock swales through planting beds.

C. Vegetation Protection: Contractors are responsible for protection of existing vegetation labeled on plans "to remain". Protection of existing vegetation includes supply and installation of protective fencing around all existing planting areas.

D. Bed Preparation and herbicide: All planting areas shall be free of weeds, grass, insects, or any other deleterious material prior to bed preparation. Contractor shall herbicide all planting areas with 'RoundUp' or approved equal at least two times prior to installation of any new plants. Pre-emergent herbicide shall be applied after planting and before placement of mulch.

E. Planting Beds: Excavate 12" of existing soil within planting beds and replace with 8" of imported topsoil and 2" of premium compost. Mechanically till into top six inches of bed until a loose, friable soil condition is met. Final grades within all planting beds shall be 2-3" below adjacent curbs to allow for mulch. Contractor to ensure positive drainage throughout all landscape areas. Adjust grades as necessary to direct water away from planting beds. Report any discrepancies on all drainage issues in writing to Civil Engineer and SSP. SSP Design to approve planting beds prior to planting operations.

F. Edging: Edging shall be installed as shown on plans. Edging shall allow for tapered drainage points to ensure free drainage away from all structures and walkways. Edging shall be set flush with adjacent paving, sidewalks or driveways.

G. Grass Areas: Scarify, float and fine grade all areas to receive sod or hydromulch for approval by SSP prior to placement of sod or application of hydromulch. Supply additional topsoil as necessary to fill any/all low areas and ensure positive drainage away building / planting beds.

H. Berms and Mounding: Supply topsoil and construct berms as indicated on plans. Berms shall have a maximum slope of 1:4. SSP to approve berming and mounding prior to planting operations.

I. Planting:
1. Installation:
    a) Excavate planting pit to depth and width indicated on Drawings.

b) Set root ball on undisturbed or compacted soil in planting pit. Remove burlap, rope, wire, and all other wrapping material from top of ball. Remove any binding rope which is not biodegradable completely.
c) Fill planting pit 2/3 full with planting mix, soak with water and allow settling, and adding fertilizer tablets as detailed. Finish filling pit with planting mix and tamp lightly.
d) Construct a watering basin as detailed and install 2 in. of mulch. Water-in to completely saturate the root ball and planting mix. Add planting mix where any settling or air pockets occur.
e) Stake all trees/palms immediately after planting as detailed.

2. Palms: New Washingtonia palms shall be cleaned (skinned) completely of their leafstem bases and fibers to a height 4 feet below the crown. Sabal palms shall be planted with their leafstem bases remaining but cleaned and trimmed evenly. All palms shall be planted with several petioles or fronds tied up straight with natural twine. Remaining fronds shall be trimmed or 'hurricane cut' to lighten wind load on terminal bud. Contractor is responsible for removing or cutting the twine supporting the fronds at the appropriate time. All palms must be inspected and approved on site by SSP Design prior to installation.

3. Shrubs: All plants shall be of species denoted on plans and shall be container-grown material at specified sizes. All plants shall be of size equal or greater than T.A.N. standards for their respective container size. All material shall be vigorous, well established, of good form consistent of species, free of disease and insects, with large healthy root systems and with no evidence of being restricted or damaged. All plants shall be inspected and approved on site by SSP Design prior to installation.

4. Planting Holes: All tree/palm holes shall be excavated with a diameter at least two times the rootball size and to a depth equal to the height of the rootball. The bottoms and sides of each hole shall be scarified with a pick to allow for free drainage and maximum root penetration. Excavate french drain in bottom of planting hole per details including filter fabric and pea gravel for percolation. After tree/palm placement, the hole shall be backfilled with a mixture of excavated soil and premium compost mixture (9 Kids Compost or approved equal). All holes shall be tested/inspected by SSP Design for free drainage prior to installation of trees.

5. Watering Basins: Watering basins for all trees/palms that do not have tree rings shall be constructed in a ring shape around each tree or palm trunk. This earthen berm shall be constructed 6" in height and 36" in diameter so as to hold water and allow infiltration around root ball. A minimum of 2 inches of specified mulch in schedule shall be placed within the watering basin. Watering basins must be maintained and kept free of weeds during the entire maintenance period.

6. Tree Rings: Install edging (concrete or aluminum as specified) in ring shape around trees as shown in plans. Tree rings shall be set level and flush or no more than 1" above finished grade with sod or hydromulch. Tree rings shall be formed in a perfect circular shape without bends, angles, or crimps.

J. Insect and Disease Control: Apply treatment as frequently as required during construction and 90-day maintenance period to prevent damage to plant material. Use only chemicals specifically approved by TNRCC.

K. Pruning: All existing and new vegetation shall be pruned/trimmed by a Certified I.S.A. Arborist as directed on site by SSP Design.

3.03 CLEANUP AND PROTECTION

A. Remove debris from landscaped areas daily and sweep clean adjacent pavements, if soiled by landscape activities.

B. Provide temporary barriers or fences as required to protect landscaping from damage or theft until final acceptance.

3.04 CLOSE-OUT DOCUMENTS

A. As-Built Drawings: Submit 'As-Built' drawings before project close-out showing the landscape layout, including revised plant material, and other installation information.

B. Warranty Letters: Submit warranty letters for trees / palms / lawns / shrubs / amenities.

END OF SECTION

SECTION 02930 – LAWNS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: The establishment of a complete and uniform lawn by sodding and/or hydromulching.

B. Related Sections:

1. Section 02810-Irrigation
2. Section 02900-Planting

1.03 QUALIFICATIONS

A. Lawn work to be performed by a single firm specializing in commercial landscape work with a minimum of five (5) years experience on similar type projects. Owner/SSP Design to review qualifications and approve subcontractor prior to commencing work.

1.02 SUBMITTALS

A. Submittals shall be formatted electronically in a pdf file with a table of contents and tabs identifying each section. The following submittals are required for this section:

1. Product Data: Manufacturer's specifications and application instructions for fertilizer.

2. Hydromulch mixes, percentages, lbs per acre, etc. for SSP review and approval before application.

3. Samples: Topsoil, compost, silica sand for SSP review and approval before installation.

4. Certificates: Inspection certificate from Texas Department of Agriculture indicating sod has been found free of diseases, insects and larvae.

5. Certificates: Breakdown of seed types, percentages, and mixture composition.

6. Sod Delivery Tickets: One per truckload indicating sod species, nursery certification, date and time of cutting.

1.03 DELIVERY, STORAGE AND HANDLING

A. Sod Delivery: Have sod delivered within forty-eight hours of cutting. Stack sod with roots to roots, protected from exposure to elements during shipment.

B. Storage: Lay sod as soon a practicable after delivery. If installation is delayed more than four hours, store sod under shade and keep constantly moist. Sod must be laid within forty-eight hours of cutting. Do not pile more than two foot depth of sod. Do not tear, stretch or drop sod. Do not allow soil to break free of turf roots.

1.04 PROJECT CONDITIONS

A. Utility Construction: Do not lay sod or begin hydro-mulching until all underlying utility work is complete, trenches backfilled, compacted and graded, and topsoil placed and fine graded.

1.05 MAINTENANCE/WARRANTY

A. Maintenance Service: Maintain the work of this Section until the Date of Substantial Completion and ninety (90) days thereafter until a complete and uniform lawn has been established and accepted by the Owner / SSP.

1. Establish hydro-mulched or sodded lawns per planting plans. Reapply hydro-mulch or re-sod as necessary until **full and uniform** coverage is obtained.
2. Mow general lawn areas **at least once per week** to maintain height of grass at 2 inches or as directed by Owner/SSP. Mowing of general lawn areas may be carried out using standard rotary type mowing equipment.
3. Mow Sports Fields **at least twice per week** to maintain an initial height of 2" for the establishment period then begin lowering the height over the next 90-days to achieve a final height of one inch. Mowing of Sports Field areas shall be carried out using reel type mowers only. Rotary mowers will not be accepted for Sports Field maintenance.
4. Trim/edge all lawn areas adjacent to watering basins, pavements, driveways, walls, structures, curbs, planting beds, edges and islands.
5. Provide insect and disease control to maintain health of grass.
6. Apply pre and post emergent herbicides as required or directed to control weed growth throughout the establishment and maintenance periods.
7. Fertilize general lawn areas (minimum two applications) with balanced commercial grade lawn fertilizer until complete and uniform coverage is obtained.
8. Fertilize Sports Field areas (minimum four applications) using a high nitrogen formula such as HJ 25-0-0 with Wolftrax or Scotts Sierrablen 27+5+5+Fe or Scotts Fairwaymaster 20+5+8 or approved equal.
9. Verti-cut or de-thatch Sports Field turf at least one time during the maintenance period.
10. Apply top dressing (clean inorganic sand) to level any divots, depressions or low spots during the maintenance period.
11. Irrigation:
    a) If the irrigation system is operating, program and monitor the system to provide adequate water for grass.
    b) If the irrigation system is not operating, hand water grass.
12. Submit receipts/dates of all maintenance operations to SSP Design for approval.

B. Warranty: Warranty shall cover all lawn grasses for a period of three months from the date of final acceptance. Final acceptance will not be approved until full and uniform lawns are completely established and proof of all fertilizations including receipts have been reviewed and accepted.

PART 2 PRODUCTS

2.01 MATERIALS

A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; minimum pH value of 5.4 and maximum 7.0; organic matter to exceed 1.5%, magnesium to exceed 100 units; phosphorus to exceed 150 units; potassium to exceed 120 units; soluble salts/conductivity not to exceed 900 ppm/0.9 mmhos/cm in soil.

B. Sand: For athletic/sports fields. Silica sand, clean, screened and free of debris. (Mathis Sand, Wright Materials Plant-1, Tel. (361) 387-0293 or approved equal).

C. Sod: (See schedule for type). Provide premium #1 certified sod grown in a sod nursery on sandy soil, at least 1 yr. old with a heavy top and a strong, well-knit root system, and not more than five percent weeds or foreign grasses.

D. Hydromulch Material. Material for hydraulic mulching shall consist of virgin wood fibers manufactured expressly from clean whole wood chips. The chips shall be processed in such a manner as to contain no growth or germination inhibiting factors. Fiber shall not be produced from recycled materials such as sawdust, paper, cardboard, or residue from pulp and pure plants. The wood cellulose fiber mulch shall be dyed green to aid in visual metering during application. The dye shall be biodegradable and not inhibit plant growth. The wood cellulose fibers of the mulch must maintain uniform suspension in water under agitation. Upon application, the moist material shall form a blotter-like mat covering the ground. This mat shall have the characteristics of moisture absorption, percolation, and shall cover and hold seed in contact with the soil. The Contractor shall obtain certifications from suppliers that laboratory, field-testing of their product has been accomplished, and that it meets all of the foregoing requirements pertaining to wood cellulose fiber mulch. Terra-Mulch Terra-Blend with UltraGro or approved equal.

E. Fertilizer: Proper fertilizer (typically 17-17-17) shall be used in hydro-mulch mix, depending on condition of soil. The Contractor shall provide a Soil Analysis Report, if requested, and shall use report to determine quantity and ratio of fertilizer for sustained growth of grass.

F. Soil and Mulch Tackifier: Tackifier used with mulch shall be organic. Tackifier shall be mixed and applied with the hydromulch at an appropriate rate to stabilize soils and minimize erosion. Tackifier shall be pH stable with fertilizer, and shall hydrate and disperse in mixing tank with water and other materials to form homogeneous slurry. Tackifier shall leave loose, chain-like stabilizing film on surface of soil, allow moisture to percolate into soil during seed germination and seedling growth, and break itself down through microbial action. Tackifier shall not inhibit plant germination or growth.

1. Organic Tackifier. Organic tackifier shall be, starch-based tackifier formulated for use with conventional mulches. Active ingredient in tackifier shall be 100 percent derived from plant starch.
2. Dry powder tackifier shall be blended with insolubilizer. After blending and mixing with water, tackifier shall swell, become sticky, and be suitable for use during heavy rain. Tackifier shall be applied at rate of 80 pounds per acre. Emulsion shall cure on surface of soil and become insoluble. Tackifier shall not inhibit plant germination or growth.

G. Fertilizer: 12-4-8 (N-P-K), formulated for slow-release Nitrogen.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Examine the site and conditions under which this work is to be performed. Have the installer notify the Contractor in writing, with a copy to SSP Design, if the site is unsatisfactory. Do not begin the work until unsatisfactory conditions have been corrected in a manner acceptable to installer. Beginning of work indicates acceptance of the site as satisfactory by the installer.

3.02 PREPARATION

A. Topsoil: Refer to Section 02900 ‘Landscaping’ for topsoil amendment.

B. Site Preparation: Contractors must visit and review site prior to bidding. Compacted soils and sub-soils from construction activities must be ripped and tilled until a loose, friable and free-draining condition is met. All existing weeds, grass, stabilized sub-base material, rubble, excavated soil and other material shall be removed from the site and disposed of by the contractor prior to starting any new landscape work. Soil conditions around entire site must be approved by SSP Design prior to rough and finished grading operations. Contractor shall not install any fill or topsoil in landscape areas prior to site condition approval by SSP Design.

3.03 INSTALLATION – HYDROMULCH

A. All exterior ground within the limit of contract or any other areas site areas disturbed by construction for egress, laydown areas, storage areas, staging areas, etc. shall be hydromulched or planted as shown on drawings. Furnish topsoil, finish grading, hydromulch and maintain areas as indicated on the drawings.

B. Lawn Area Preparations - Grade areas to finish grades, filling as needed or removing surplus material. Float all lawn areas to a smooth, uniform grade as indicated on engineers grading plans. All lawn areas shall slope to drain away from structures and planting beds. Where no grades are shown, areas shall have a smooth and continual grade between existing or fixed controls (such as walks, curbs, catch basin, elevational steps or structures) and elevations shown on plans. Contractor to ensure proper drainage around all structures. Adjust grades as necessary to direct water away from structures and planting beds. Report any discrepancies on all drainage issues in writing to SSP Design or the project engineer.

C. Roll, scarify, rake and level as necessary to obtain true, even lawn surfaces. All finish grades shall meet approval of the SSP, before seeding/hydromulching operations. Loosen soil to a depth of three inches (3") in lawn areas by approved method of scarification and grade to remove edges and depressions. Remove stones or foreign matter over one half inch (1/2") in diameter from the top two inches (2") of soil. Float lawn areas to finish grades as shown on civil plans.

D. Lawn areas should be permitted to settle or should be firmed by rolling before seeding/hydromulching.

E. Hydromulching shall not be performed in windy weather.

F. Lawn areas shall be seeded by hydro-mulching evenly with an approved mechanical hydro-mulcher. Hydromulch mixture shall include a minimum of 3 lbs. seed, 45-50 lbs. of wood fiber mulch, 20 lbs. of fertilizer, and tackifier per 1000 sq. ft. Contractor shall add fresh annual rye grass seed if hydromulching between the months of November to April. In areas inaccessible to hydro-mulching equipment, the seeded ground shall be lightly raked with flexible rakes and rolled with a water ballast roller. After rolling, seeded areas are to be lightly mulched with wheat straw or approved erosion control material.

G. Lawns shall be maintained by the Contractor for at least 90 days after substantial completion or as long as necessary to establish a uniform stand of the specified grasses, or until final acceptance of lawns, whichever is later.

H. Water seeded/hydromulched areas twice the first week to a minimum depth of six inches (6") with a fine spray and once per week thereafter as necessary to supplement natural rain to the equivalent of one inch (1") or to a six-inch (6") depth.

I. The surface layer of soil for seeded/hydromulched areas must be kept moist during the germination period. After first cutting, water as specified above.

J. Make weekly inspections to determine the moisture content of the soil and adjust the watering schedule established by the irrigation system installer to fit conditions

K. After grass growth has started, all areas or parts of areas, which fail to show a uniform stand of grass for any reason whatsoever shall be reseeded/hydromulched in accordance with the plans and as specified herein. Such areas and parts of areas shall be reseeded, hydromulched or sodded repeatedly until all area are covered with a satisfactory growth

of grass at no additional cost to the Owner.

L. Watering shall be done in such a manner and as frequently as is deemed necessary by SSP to assure continued growth of healthy grass. All areas of the site shall be watered in such a way as to prevent erosion due to excessive quantities applied over small areas and to avoid damage to the finished surface due to the watering equipment.

M. Water for the execution and maintenance of this work shall be provided by the Owner at no expense to the Contractor. The Contractor shall, however, furnish his own portable tanks, pumps, hose, pipe, connections, nozzles, and any other equipment required to transport the water from the available outlets and apply it to the seeded area in an approved manner.

N. Mowing of the seeded, hydromulched or sodded areas shall be initiated when the grass has attained a height of one and one-half to two inches (1-1/2" to 2"). Grass height shall be maintained between one and one and one-half inches (1' to 1½") at subsequent cutting depending on the time of year. Not more than one third (1/3) of the grass leaf shall be removed at any cutting and cutting shall not occur more than seven (7) days apart.

O. When the amount of grass is heavy, it shall be removed to prevent destruction of the underlying turf. If weeds or other undesirable vegetation threaten to smother the planted species, such vegetation shall be mowed or, in the case of rank growths, shall be uprooted, raked and removed from the area by methods approved by the SSP.

P. Protect seeded/hydromulched areas against trespassing while the grass is germinating. Furnish and install fences, signs, barriers or any other necessary temporary protective devices. Damage resulting from trespass, erosion, washout, settlement or other causes shall be repaired by the Contractor at their expense.

Q. Remove all fences, signs, barriers or other temporary protective devices after final acceptable.

3.04 INSTALLATION – SOD

A. Sod shall be installed to all areas as indicated on plans.

B. Sod Bed Preparation - Grade areas to finish grade, filling as needed or removing surplus dirt, stone, debris, etc. and floating areas to a smooth, uniform grade as indicated on grading plans. All lawn areas are to slope to drain.

C. Sod shall be laid within 24 hrs of being cut. Only healthy vigorous growing sod is to be laid.

D. Always lay sod across slope and tightly together so as to make a solid area.

E. Roll all new sod with a 1 ton mechanical vibratory roller sufficiently to set or press sod into underlying soil and to level all seams and joints.

F. Contractor to fill any gaps or seams in the sodded areas using clean top dressing sand.

G. After sodding has been completed, clean up and thoroughly moisten by sprinkler newly sodded areas.

3.05 FERTILIZING – GRASS

A. General lawn areas shall have fertilizer applied in two (2) applications with a thorough watering immediately following each application. The first application shall be one (1) week after the hydro-seeding using a 'starter fertilizer' at manufacturer's recommended rates. The second application shall be done after 30-60 days with an approved turf builder fertilizer at manufacturer's recommended rates and as approved by SSP.

B. Sports Field areas shall have a minimum of four (4) applications with a thorough watering immediately following each application. The first application shall be one (1) week after the hydro-seeding using a 'starter fertilizer' at manufacturer's recommended rates. Subsequent applications shall be done after 30 days, 60 days and 90 days with a balanced or higher nitrogen fertilizer at manufacturer's recommended rates and as approved by SSP.

C. Soil analysis and time of year shall be considered with SSP to determine fertilizer type, composition and final application rates . Submit fertilizer type and analysis to SSP for approval before any application. Document fertilizer application with photos and receipts of fertilizer purchases.

3.06 CLEANUP AND PROTECTION

A. Remove debris from landscaped areas daily and sweep clean adjacent pavements, if soiled by landscape activities.

B. Protect lawns from damage, theft or vandalism until final acceptance. Install stakes and flagging or temporary fencing if required to keep traffic off newly established lawn areas.

END OF SECTION

SECTION 03010 CONCRETE WORK

PART 1 GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work specified in this section.

DESCRIPTION OF WORK:

Extent of concrete work shown on drawings.

Concrete paving and walks are specified in Division 2.

Precast concrete is specified in other Division 3 sections.

QUALITY ASSURANCE:

Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:

ACI 301 "Specifications for Structural Concrete for Buildings".

ACI 318 "Building Code Requirements for Reinforced Concrete."

Concrete Reinforcing Steel Institute, "Manual of Standard Practice".

Concrete Testing Service: The Owner shall employ a testing laboratory to perform material evaluation tests and to design concrete mixes.

Materials and installed work may require testing and retesting, as directed by Architect, at any time during progress of work. Allow free access to material stockpiles and facilities. Tests, including retesting of rejected materials and installed work, shall be done at Contractor's expense.

SUBMITTALS:
Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry shake finish materials, and others as requested by Architect.

Shop Drawings; Reinforcement: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement. Include special reinforcement required at openings through concrete structures.

Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test as specified.

PART 2 PRODUCTS

FORM MATERIALS:
Forms for Exposed Finish Concrete: Unless otherwise indicated, construct formwork for exposed concrete surfaces with plywood, metal, metal framed plywood faced or other acceptable panel type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.

Forms for Unexposed Finish Concrete: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

Form Coatings: Provide commercial formulation form coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

REINFORCING MATERIALS:

Reinforcing Bars (Rebar): ANSI/ASTM A 615, Grade 60, deformed. No. 3 bars may be grade 40.

Welded Wire Fabric (WWF): ANSI/ASTM A 185, welded steel wire fabric.

Supports for Reinforcement: Provide brick bat supports for reinforcement for supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI recommendations, unless otherwise acceptable.

For slabs on grade: Use Brick bats (1/2 of full brick) to support slab and beam reinforcing.

For exposed to view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class I) or stainless steel protected (CRSI, Class 2).

CONCRETE MATERIALS:

Portland Cement: ANSI/ASTM C 150, Type I.

Use one brand of cement throughout project, unless otherwise acceptable to Architect.

Normal Weight Aggregates: ANSI/ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete.

Water: Potable.

Moisture Barrier: Provide moisture barrier cover over prepared base material where indicated. Use only materials which are resistant to decay when tested in accordance with ANSI/ASTM E 154, as follows:

Clear Polyethylene Sheet not less than 6 mils thick.

Chemical Hardener (ChHd Fn): Colorless aqueous solution containing a blend of magnesium flousilicate and zinc flousilicate combined with a wetting agent, containing not less than 2 lbs. of flousilicates per gal.

Non slip Aggregate Finish (NSAg Fn): Provide fused aluminum oxide grits, or crushed emery, as abrasive aggregate for non slip finish with emery aggregate containing not less than 40% aluminum oxide and not less than 25% ferric oxide. Use material that is factory graded, packaged, rust proof and non glazing, and is unaffected by freezing, moisture and cleaning materials.

Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

Moisture Retaining Cover: One of the following, complying with ANSI/ASTM C 171.

10 mil polyethylene vapor barrier (clear).

Liquid Membrane Forming Curing Compound: (Typical): ASTM C309 Type 1; approved by Asphalt and Vinyl Composition Tile Institute; 30% minimum solids content.

Products: offered by manufacturers to comply with the requirements for membrane forming curing compounds include the following:

"Klearseal:; Setcon Industries.
"Floor Coat"; The Eeuclid Chemical Corp.
"MB 429"; Master Builders
"Kure N Seal 800"; Sonneborn Contech.
"Klorkure 800"; Setcon Industries.
"Clear Seal 800"; W. R. Grace
"Dress and Seal"; L & M Construction Chemicals.
"Sealco 800"; Gifford Hill.

Note: Verify that selected product will not affect bonding of subsequent wall finishes or floor coverings.

PROPORTIONING AND DESIGN OF MIXES:
Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to Architect for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing unless otherwise acceptable to Architect.

Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Architect.

Design mixes to provide normal weight concrete with the following properties unless otherwise noted on the structural drawings, as indicated on drawings and schedules:

All concrete, except curb concrete, shall be flowable concrete comprised of:

1. Not less than 470# (5 sacks) of cement Type I per yard of concrete. (Unless water reducing agent is provided.)

2. Water reducer shall be used equal to WRDA No. 79, 20 oz. per yard by manufacturer by Grace Chemical.

3. Air 2% to 5 %.

4. 5" max. slump after additive placed in mix.

5. All concrete shall have a minimum compressive 28 day strength of 3,000 PSI. (Unless noted otherwise on construction drawings.)

Design Test cylinders and compression breaks of the above mix shall be submitted to the Architect/Engineer for approval. Should cylinders fail to meet specifications, the cement added shall be increased to satisfy the required strength.

Curb concrete shall be 4 sack per yard minimum cement factor and have a w/c maximum ratio of 0.65 with a minimum 28 day compressive strength of 2,500 PSI. Max slump shall be 3".

CONCRETE MIXES:

Ready Mix Concrete: Comply with requirements of ANSI/ASTM C 94, and as herein specified.
Addition of water to the batch will not be permitted.

During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.

When air temperature is between 85 degrees F (30 degrees C) and 90 degrees F (32 degrees C), reduce mixing and delivery time from 1 1/2 hours to 75 minutes, and when air temperature is above 90 degrees F (32 degrees C),reduce mixing and delivery time to 60 minutes. Ice or other means of cooling shall be added to mix should concrete exceed 95 deg. F.

Admixtures:

Use air entraining in all concrete, unless otherwise shown or indicated. Add air entraining admixture at the manufacturer's prescribed rate to result in concrete at point of placement having air content within the following limits: 2% to 5% air.
When air entrainment is used, reduce the maximum water content of the design mixes.

A water reducing additive such as Master Builders' Pozzolith or Gifford Hills' PSI shall be used for all concrete. Such shall be used in strict compliance with manufacturer's recommendations, such as to provide a flowable mix.

Use amounts of admixtures as recommended by the manufacturer for climate conditions prevailing at the time of placing. Adjust quantities of admixtures as required to maintain quality control. All such shall be subject to approval of the Engineer and Architect.

Calcium Chloride: Do not use calcium chloride in concrete, except as otherwise authorized in writing by the Architect. Do not use any admixtures containing calcium chloride where concrete is placed against any galvanized steel, post tension steel or in any mix using high early strength cement.

PART 3 EXECUTION

FORMS:
Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position. Use wood forming for the full surfaces of the exterior side of all grade beams.

Design formwork to be readily removable without impact, shock or damage to cast in place concrete surfaces and adjacent materials.
Construct forms to sizes shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.

Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.

Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.

Chamfer exposed corners and edges as indicated, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.

Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.

PLACING REINFORCEMENT:
Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.

Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.

Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support

reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

Chuting of concrete in excess of 25' (twenty five feet) of slab perimeter is not approved. "Pumping Placement" of all concrete shall be required of all foundation work beyond 25' (twenty five feet) of perimeter.

JOINTS:

Construction Joints: Locate and install construction joints, which are not shown on drawings, so as not to impair strength and appearance of the structure, as acceptable to Architect.

Provide keyways at least 1 1/2" deep in construction joints in walls, slabs and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs.

Place construction joints perpendicular to the main reinforcement. Continue reinforcement across construction joints.

Joint sealant materials are specified in Division 7 sections of these specifications.

INSTALLATION OF EMBEDDED ITEMS:

General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast in place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto.

Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike off templates or accepted compacting type screeds.

PREPARATION OF FORM SURFACES:
Coat contact surfaces of forms with a form coating compound before reinforcement is placed.

Thin form coating compounds only with thinning agent of type, and in amount, and under conditions of form coating compound manufacturer's directions. Do not allow excess form coating material to accumulate in forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

CONCRETE PLACEMENT:
Contractor shall notify Architect's office 48 hours prior to placement of concrete for on-

site visual inspection by Structural Engineer.

Preplacement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.

General: Comply with ACI 304and as herein specified.

Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.

Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

Consolidate placed concrete by mechanical vibrating equipment supplemented by hand spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI recommended practices.

Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

Maintain reinforcing in proper position during concrete placement operations.

Cold Weather Placing: Place no concrete when temperature is less than 40 degrees F or 45 degrees F and falling.

Hot Weather Placing: When hot weather conditions exist that would seriously impair

quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

Cover reinforcing steel with water soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

Wet forms thoroughly before placing concrete.

FINISH OF FORMED SURFACES:

Rough Form Finish: For formed concrete surfaces not exposed to view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.

Smooth Form Finish: For formed concrete surfaces exposed to view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, painting or other similar system. This is as cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.

Smooth Rubbed Finish: Provide smooth rubbed finish to scheduled concrete surfaces, which have received smooth form finish treatment, not later than one day after form removal.

Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.
Related Uniformed Surfaces: At tops of walls, horizontal offsets surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

MONOLITHIC SLAB FINISHES:
Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated.

After placing slabs, plane surface to a tolerance not exceeding 1/2" in 10' when tested with a 10' straightedge. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms or rakes.

Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand bed terrazzo, and as otherwise indicated.

After screening, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power driven floats, or both. Consolidate

surface with power driven floats, or by hand floating if area is small or inaccessible to power units. Check and level surface plane to a tolerance not exceeding 1/4" in 10' when tested with a 10' straight edge. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed to view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint or other thinfilm finish coating system.

After floating, begin first trowel finish operation using a power driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand troweling operation, free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding

1/8" in 10' when tested with a 10' straightedge. Grind smooth surface defects which would telegraph through applied floor covering system.

Non Slip Broom Finish: Apply non slip broom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated.

Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

Chemical Hardener Finish: Apply chemical hardener finish to interior concrete floors where indicated. Apply liquid chemical hardener after complete curing and drying of the concrete surface. Dilute liquid hardener with water, and apply in 3 coats; first coat, 1/3 strength; secondcoat, 1/2 strength; third coat, 2/3 strength. Evenly apply each coat, and allow 24 hours for drying between coats.

Apply proprietary chemical hardeners, in accordance with manufacturer's printed instructions.

After final coat of chemical hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

Non slip Aggregate Finish: Apply non slip aggregate finish to concrete stair treads, platforms, ramps, and elsewhere as indicated.

After completion of float finishing, and before starting trowel finish, uniformly spread 25 lbs. of dampened non slip aggregate per 100 sq. ft. of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as herein specified.

After curing, lightly work surface with a steel wire brush, or an abrasive stone, and water to expose non slip aggregate.

CONCRETE CURING AND PROTECTION:

General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 72 hours.

Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

Curing Methods: Perform curing of concrete by moist curing, by moisture retaining cover curing, by curing compound, and by combinations thereof, as herein specified.

Provide moisture curing by following methods.

Keep concrete surface continuously wet by covering with water.

Continuous water fog spray.

Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.

Provide moisture cover curing as follows:
Cover concrete surfaces with moisture retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

Provide curing compound to slab as follows:
Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's directions. Recoat areas immediately after initial application. Maintain continuity of coating and repair damage during curing period. Apply 2 separate coatings of spray cure. Second coat shall be applied in a pattern at 90 deg. to the first coat.

Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring, painting, and other coatings and finish materials, unless otherwise acceptable to Architect.
Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of appropriate curing compound. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture retaining cover, unless otherwise directed.

REMOVAL OF FORMS:

Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 degrees F. (10 degrees C) for 24 hours after placing concrete, provided concrete is

sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

Formwork supporting weight of concrete, such as beam soffits, joints, slabs and other structural elements, may not be removed in less than 14 days and until concrete has attained design minimum compressive strength at 28 days. Determine potential compressive strength of inplace concrete by testing field cured specimens representative of concrete location or members.

Form facing material may be removed 4 days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

RE USE OF FORMS:

Clean and repair surfaces of forms to be re used in work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.

When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Architect.

MISCELLANEOUS CONCRETE ITEMS:

Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in place construction. Provide other miscellaneous concrete filling shown or required to complete work.

Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

CONCRETE SURFACE REPAIRS:

Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect.

Cut out honeycomb, rock pockets, voids over 1/4" in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water and brush coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.

For exposed to view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.

Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.

Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having required slope.

Repair finished unformed surfaces that contain defects which affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement or completely through non reinforced sections regardless of width, spalling, pop outs, honeycomb, rock pockets, and other objectionable conditions.

Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.

Correct low areas in unformed surfaces during, or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to Architect.

Repair defective areas, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4" clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact and finish to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.

Repair isolated random cracks and single holes not over 1" in diameter by dry pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry pack, consisting of one part portland cement to 2 1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry pack after bonding compound has dried. Compact dry pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

Use epoxy based mortar for structural repairs, where directed by Architect.
Repair methods not specified above may be used, subject to acceptance of Architect.

QUALITY CONTROL TESTING DURING CONSTRUCTION:
The Owner will employ a testing laboratory to perform other tests and to submit test reports.

Sampling and testing for quality control during placement of concrete may include the following, as directed by Architect.

Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

Slump: ASTM C 143; the first three trucks will be tested for adequate slump, and every fifth truck thereafter. Those trucks exceeding the maximum 5" slump WILL NOT BE ACCEPTED.

Compression Test Specimen: ASTM C 31; one set of 3 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field cure test specimens are required. All making and handling of test specimens shall be by Laboratory personnel.

Compressive Strength Tests: ASTM C 39; one set for each 50 cu. yds.or fraction thereof, of each concrete class placed in any one day for each 5,000 sq. ft. of surface area placed: 1 specimen tested at 7 days, 1 specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive by more than 500 psi.

Test results will be reported in writing to Architect and Contractor on same day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7 day tests and 28 day tests.

Additional Tests: The testing service will make additional tests of in place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

END OF SECTION 03010

SECTION 03200 - CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Reinforcing steel, welded wire fabric, tie wires and other related accessories.

B. Work includes reinforcing for interior and exterior cast-in-place concrete and reinforced concrete unit masonry Work.

1.02 RELATED SECTIONS

A. Section 03300 - Cast-In-Place Concrete.

1.03 REFERENCES

A. American Concrete Institute (ACI):
   1. 301, Structural Concrete.
   2. 315, Manual of Standard Practice for Detailing Reinforced Concrete Structures.
   3. 318, Building Code Requirements for Reinforced Concrete.

B. American Society for Testing and Materials (ASTM):
   1. A82, Cold Drawn Steel Wire for Concrete Reinforcement.
   2. A185, Welded Steel Wire Fabric for Concrete Reinforcement.
   3. A615, Deformed and Plain Billet Steel Bars for Concrete Reinforcement (including supplementary requirements)

C. Concrete Reinforcing Steel Institute (CRSI):
   1. Manual of Practice.
   2. 63, Recommended Practice For Placing Reinforcing Bars.
   3. 65, Recommended Practice for Placing Bar Supports, Specifications and Nomenclature.

1.04 SUBMITTALS

A. Submit:
   1. Shop drawings. Provide electronic (pdf format) file of submittals. Electronic submittals shall be organized into a single pdf file.
      a. Show reinforcing steel and wire fabric sizes, spacings, locations and quantities, bending and cutting schedules and supporting and spacing devices.
      b. Indicate visual method of identification of bar strengths following ASTM standard for steel type used.
   2. Certified copies of mill test reports of reinforcement materials analysis (upon request).

B. Provide submittals within 30 days after Contract date.

1.05 QUALITY ASSURANCE

A. Maintain 1 copy of each referenced document at Site.

B. Fabrication and Placement Tolerances: Follow ACI 301.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver to Site free of rust and scale, clearly marked as to bar strength.

B. Store reinforcing materials on pallets or other materials off ground. Avoid surface contamination before placement and prevent bending or warping.

1.07 ALLOWANCE

A. Include in lump sum allowance for additional reinforcing steel material (fabricated and installed) required to complete the work equal to 3.0 tons of reinforcing steel any unused tonnage will be credited to the owner at a cost of $2,000.00 per ton.

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing Steel: ASTM A615, Grade 60 (60,000 psi yield strength) billet steel bars; unfinished. Provide in sizes shown on plans provide deformed bars typically and plain bars where dowels are shown.

B. Stirrup Steel: #3 reinforcing bars may by ASTM A615 Grade 40.

C. Welded Wire Fabric (WWF): ASTM A185, plain type; unfinished. Provide in sheet form not in rolls. Provide as sized if shown or as follows if not shown:
   1. Provide 1 layer of 6 x 6 W1.4/W1.4 in sidewalk and toppings 4" or less in thickness.

2.02 ACCESSORIES

A. Tie Wire: Minimum 16 gauge (0.06") annealed type.

B. Chairs, Bolsters, Bar Supports and Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions.

C. Special Chairs, Bolsters, Bar Supports and Spacers Adjacent to Weather Exposed Concrete Surfaces: Stainless steel type; sizes and shapes required.

2.03 FABRICATION

A. Fabrication: Follow CRSI Manual of Practice.

B. Locate reinforcing splices not shown at points of minimum stress.

PART 3 EXECUTION

3.01 PREPARATION

A. Foundations and Footings:
   1. Clean excavations of loose debris and earth. Cut sides of excavations square and remove loose material.
   2. Pump out standing water from excavations before placing reinforcement. Remove and replace mud or frozen soil with lean concrete.

B. Clean reinforcement completely before concrete placement. Reinforcement shall be free from loose, flaky rust, mud, oil or other coatings that would destroy or reduce bond with concrete at time concrete is placed. Re-inspect reinforcement and clean off any dried cement, mortar or dirt when placement is delayed.

C. Obtain Owner's Engineer's approval of reinforcement installations prior to placement of any concrete.

3.02 ERECTION / INSTALLATION / APPLICATION

A. Position reinforcement following ACI 301, ACI 315 and drawn details.

B. Provide reinforcing steel in concrete footings, foundation walls, thickened slabs, retaining walls and elsewhere shown.

C. Provide reinforcing steel in concrete unit masonry walls, bond beams and elsewhere shown.

D. Provide corner reinforcing steel in footings at corners and at intersections of walls unless shown otherwise:
   1. Bar size and spacing shall match wall or footing reinforcing.
   2. Return bars minimum of 36 diameters on each end.
   3. WELDING OF REINFORCING IS NOT PERMITTED.

E. Provide the following minimum concrete cover requirements for reinforcing steel unless shown otherwise:
   1. Concrete Cast Against and Permanently Exposed to Earth: 3".
   2. Concrete Exposed to Earth or Weather:
      a. #5 Bars and Smaller: 1-1/2".
      b. Others: 2".

F. Provide minimum splice requirements for reinforcing steel shown or required by ACI 318. Stagger splices so that no more than 1/2 of horizontal reinforcing steel is spliced at any given cross section.

G. Provide a bond breaker such as plastic sleeves at all dowel bars occurring at control and expansion joints.

H. Place, support and secure reinforcement against displacement. Do not deviate from required position.
   1. Provide bolsters and chairs required to maintain reinforcing steel at proper elevation in slab.

I. Lap welded wire fabric minimum 6" or 1 full mesh on sides and 1 foot or 2 full meshes on ends and extend to within 2" of slab edges. Chair support welded wire fabric so that welded wire fabric is in upper half of slab while placing slabs on grade unless specifically shown otherwise.

J. Carry welded wire fabric and reinforcing steel through control (contraction) joints but not through construction and expansion joints unless shown otherwise.
   1. Grease dowels thoroughly and paper wrap to allow for horizontal movement at expansion joints.
   2. Cut alternate wires of welded wire fabric at control joints.

K. Take care to avoid disturbing reinforcement and vapor retarder during placing of concrete. Remove and reinstall disturbed or improperly installed reinforcement when discovered or instructed by Owner's Engineer before continuing concrete placement.

L. Accommodate placement of formed openings.

END OF SECTION 03200

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior and exterior plain and reinforced site-placed concrete, vapor retarders, expansion joints, curing compounds and other related accessories.

1.02 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Anchor bolts.

B. Reinforcement.

1.03 RELATED SECTIONS

A. Section 03200 - Concrete Reinforcement.

1.04 REFERENCES

A. American Concrete Institute (ACI):
1. 301, Structural Concrete.
2. 302, Guide for Concrete Floor and Slab Construction.
3. 304, Measuring, Mixing, Transporting and Placing Concrete.
4. 305R, Hot Weather Concreting.
5. 308, Curing Concrete.
6. 309, Recommended Practice for Consolidation of Concrete.
7. 318, Building Code Requirements for Reinforced Concrete.

B. American Society for Testing and Materials (ASTM):
1. C31, Making and Curing Concrete Test Specimens in the Field.
2. C33, Concrete Aggregates.
3. C39, Compressive Strength of Cylindrical Concrete Specimens.
4. C94, Ready Mixed Concrete.
5. C143, Test Method for Slump of Portland Cement Concrete.
6. C150, Portland Cement.
7. C171, Sheet Materials for Curing Concrete.
8. C172, Sampling Freshly Mixed Concrete.
9. C231, Air Content of Freshly Mixed Concrete by the Pressure Method.
10. C260, Air Entraining Admixtures for Concrete.
11. C309, Liquid Membrane - Forming Compounds for Curing Concrete.
12. C494, Chemical Admixtures for Concrete.
13. C618, Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

1.05 DEFINITIONS

A. Concealed: For Work required under this Section, the term "concealed" will mean "not exposed to view in finished construction."

B. Exposed: For Work required under this Section, the term "exposed" will mean "exposed to view in finished construction."

1.06 SUBMITTALS

A. Submit: Submittal shall be provided in electronic (pdf format) format. Electronic submittal shall be provided in a single pdf file.
   1. Concrete mix designs. Follow ACI 301. Submit a mix design for each class of concrete required within 30 days after Contract date and prior to placing any concrete.
   2. Product data including installation requirements for curing/sealer compounds, mineral and chemical admixtures and joint devices.
   3. Concrete delivery tickets.
      a. Submit to Owner's Engineer at Site.
      b. Follow ASTM C94. Also include:
         1) Batch number.
         2) Mix by class of concrete and bag content with maximum aggregate size used
         3) Air content.
         4) Quantities and types of admixtures.
         5) Slump.
         6) Time of loading.
      c. Delivery tickets not showing time of loading will be grounds for rejection of load.

   4. Testing laboratory reports.
      a. Submit directly to Owner's Engineer, Contractor and ready-mix supplier.
   5. Certification or test results indicating compliance of material or source of material with these specifications (upon request).

1.07 QUALITY ASSURANCE

A. Maintain 1 copy of each referenced document at Site.

B. Acquire cement and aggregate from same source for all Work.

C. Tolerances: Place and finish cast-in-place concrete within tolerance limits specified in ACI 301 and as follows:
   1. Formed Surfaces: Follow ACI 301 (Table 4.3.1.).

D. Acceptance Of Work: Presence or evidence of nonconforming Work shall be sufficient cause for Owner's Engineer to require entire section of concrete affected be torn out and rebuilt properly at Contractor's expense.
   1 Such unacceptable Work includes:
      a. Horizontal or vertical misalignment.
      b. Cracking.
      c. Honeycombing.
      d. Spalling.
      e. Embedded debris.
   2. If by tests or on-site observation, Owner's Engineer determines that any of Contract requirements have not been fully met in completion of this Work, he may require additional testing or retesting to determine composition, soundness and actual structural capacity of any concrete.
   3. Costs for such testing shall be paid by Contractor if such tests subsequently establish that Work is unacceptable and by Owner if Work is found to be acceptable.

4. Remove and replace all unacceptable Work including related Work which was acceptable but which must be disturbed as a result of replacement if such tests establish that Work is unacceptable with regard to compliance with these specifications.

1.08 DELIVERY, STORAGE AND HANDLING

A. Concrete Delivery: Follow ACI 304 and ASTM C94.

B. Deliver packaged materials in manufacturer's unopened, labeled containers.

C. Store materials to provide protection from weather and damage.

D. Deliver concrete in agitating or revolving type equipment. DO NOT USE NON-AGITATING EQUIPMENT.

E. Discharge concrete at Site within 1-1/2 hours or 300 revolutions, whichever comes first, after water has been added to cement and aggregates or cement batches with aggregates unless a longer time is specifically authorized by Owner's Engineer.

F. Owner's Engineer may require a reduction in this elapsed time during hot weather, when high early strength cement is being used or under other conditions contributing to quick stiffening of concrete.

1.09 PROJECT CONDITIONS

A. Coordinate Work of other trades who will furnish and install items of Work (sleeves, piping, conduit, inserts, etc.) to be cast in concrete. Place no concrete until such items are in place.
1. Anchor bolts for steel columns to be supplied by Metal Building Manufacturer to the rebar / concrete finishing contractor for installation.

B. Place concrete at ambient temperatures between 50^{o} and 95^{o}F.

C. Follow instructions for special procedures at end of this Section should it be necessary to place concrete in colder or hotter weather.

D. Protect freshly placed concrete from rainfall, water leaks, falling objects, traffic of any kind and other hazards to surfaces. Provide barricades and lights if necessary.

PART 2 PRODUCTS

2.01 MATERIALS

A. Portland Cement:
1. ASTM C150 Type I (Normal) or Type II (Moderate).
2. Cement shall be free of false set when tested following ASTM C451.
3. Use same brand, type and source throughout.

B. Aggregates:

1. Fine Aggregate: ASTM C33; natural or manufactured sand, clean, hard and durable, uncoated grains, free from deleterious matter. Average fineness modulus shall be between 2.5 and 3.0.

2. Coarse Aggregate: ACI 301 and ASTM C33.
   a. Interior and Concealed Exterior Applications: Crushed gravel or stone, durable uncoated particles free from deleterious matter.
   b. Exposed Exterior Applications: Crushed dolomite, granite or limestone.
   c. Grading: ASTM C33 No. 57.

C. Admixtures:
1. Mineral Admixtures:
   a. Fly Ash: ASTM C618 Class C or Class F; loss on ignition 6% maximum.
   b. Fly ash source must be approved by Owner's Engineer. Preapproved sources are:
      1) Class C: Boral Manufacturing
2. Chemical Admixtures:
   a. Water Reducing Admixtures: ASTM C494 Type A (Water Reducing).
      1) Type E (Water Reducing and Accelerating) may be used during cold weather and Type D (Water Reducing and Retarding) during hot weather with Engineer's prior approval.
      2) Type F (Water Reducing - High Range) or Type G (Water Reducing High Range and Retarding) admixtures (superplasticizers) may used be used with Engineer's prior approval.
   b. Calcium chloride, thiocyanates, corrosive admixtures or admixtures containing more than 0.05% chloride ions (total) are not permitted.
3. DO NOT USE ANY OTHER ADMIXTURES WITHOUT ARCHITECT'S PRIOR WRITTEN APPROVAL.

D. Water: Potable; free from objectionable quantities of foreign materials harmful to concrete such as silt, organic matter, acids, alkali, salt and other deleterious substances.

E. Vapor Retarders: Clear or black fungus resistant polyethylene or fabric reinforced plastic film recommended for below grade application; 10 mil thick.

F. Expansion Joint Filler Strips: ASTM D1751 non-extruding and resilient type, asphalt impregnated fiberboard or felt or ASTM D1752 closed cell foam with resiliency recovery of 95% if not compressed more than 50% of original thickness; 3/8" thick for interior and 1/2" thick for exterior unless shown otherwise.

G. Liquid Curing/Sealer Compound (Typical): ASTM C309 Type 1; approved by Asphalt and Vinyl Composition Tile Institute; 30% minimum solids content.

H. Sheet Curing Membranes: ASTM C171; absorptive mats, waterproof paper or polyethylene film.

2.02 CONCRETE MIXES

A. General Requirements:

1. Concrete Mixing: Follow ASTM C94. BATCH MIXING OF CONCRETE ON SITE IS NOT PERMITTED EXCEPT FOR MISCELLANEOUS MIXES.
2. Mixing Procedures: Follow ACI 301.
3. Handling and Weighing: Follow ACI 304.
4. Measure water, air entraining admixtures and water reducing admixtures by weight or volume. Measure all other materials by weight.
5. AIR ENTRAINED CEMENT IS NOT ACCEPTABLE.
   a. Provide only non-air entrained concrete.
6. Provide water reducing admixtures in all Classes of concrete Work.
7. No dry-packaged mixtures are allowed.
8. Fly ash may be provided as supplementary cementitious material in concrete Work. Fly ash content shall not exceed 25% of the cementitious material weight within a concrete batch.
9. Exposed concrete is to meet requirements for potentially destructive exposure.
10. Admixtures are to be added at batch plant.
11. Do not add water to mix on job unless previously approved by Owner's Engineer. Note amount of water added on delivery ticket.
12. Nominal maximum allowable slump of concrete (except for controlled density fill) is 4".
13. Follow Exhibit 03300 for water/cementitious ratio of concrete.
14. Provide minimum 3 day compressive strength of 1800 psi for concrete used for floors.

B. Concrete Properties and Proportions:

1. Provide concrete meeting the following properties and performance specifications

Cast-In Place Concrete (Class I)

F'c	3,000 psi (28 day compressive strength)
Portland Cement	ASTM C 150 – 86 Type 1
Fly Ash	ASTM C 618 (Maximum of 25% of cementitous material)
Slump	5" (+/- 1") measured from the discharge of the truck
Coarse Aggregate	1" maximum with gradation requirements prescribed in table 2 of ASTM C33 Size No. 57.

Provide non-air entrained concrete

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine Site conditions and excavations for earth forms to verify that they are neatly and accurately cut and correctly located.

B. Examine formwork to verify that it is sound and correctly located, that conditions are proper for concrete installation and that excavations are sufficient to permit placement, inspection and removal of forms.

C. Examine reinforcement to verify requirements for concrete cover.

D. Examine areas of Work to be cast to determine that substrates are properly installed, required reinforcement, inserts and embedded items are in place and that correct finish top of cast elevations can be obtained.
   1. Verify that conduit and piping is installed below slab. NO UTILITIES ARE TO BE BUILT INTO SLAB OR TOPPING.
   2. Verify depths of depressed conditions are correct for specified delayed finishes. Slabs to receive finishes over 1/8" in thickness shall be depressed as required to allow for alignment with adjacent finish materials.
   3. Verify base and sub-base slope correctly at floor drains. Slab thickness shall be maintained in sloped areas.

E. Do not start Work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Ensure availability of sufficient labor, equipment and materials to place concrete correctly following Project requirements and scheduled casting.

B. Notify Owner's Engineer at least 48 hours in advance of placing any concrete. Place concrete only when Owner's Engineer is present unless this requirement is specifically waived. Excavations must be inspected and approved by soils engineer.

C. Place no concrete before embedded items are in place and before forms, reinforcing and affected Work of other trades have been examined.
   1. Coordinate placement of joint devices with erection of formwork and placement of form accessories.

D. Drill holes in previously poured concrete, insert steel dowels and pack solid with non-shrink grout in locations where new concrete is dowelled to existing Work including at bases and pads.

E. Immediately Before Placing Concrete:
   1. Clean debris from forms, decks, base slabs, bottoms of forms, etc. to receive concrete.
   2. Thoroughly wet base of slabs poured directly on earth, sand, stone, concrete or gravel.
   3. Verify sizes and locations of openings required.
   4. Secure approval of conditions from Owner's Engineer. Allow a minimum of 1 hour for Owner's Engineer's inspection after installation of reinforcing and before placing concrete.

3.03 ERECTION / INSTALLATION /APPLICATION

A. Follow ACI 301.

B. Place concrete only when Owner's Engineer is present unless this requirement is specifically waived by Owner's Engineer upon notice of scheduled pour.

C. Notify Owner's Engineer not less than 48 hours (excluding holidays and weekends) in advance of placing concrete.

D. Provide concrete of following various classes unless shown otherwise.
   1. Class I: Cast-In Place Concrete .

E. Provide uniform slope at rate shown on structural foundation plans. Exterior walkways shall slope as indicated on Architectural plans.

F. Install vapor retarder under interior and exterior slabs, walks, bases and pads on grade.
   1. Lay film directly on slab base just before setting reinforcing and pouring concrete slabs. Provide widest widths practical and oriented to obtain least lineal footage of joint.
   2. Lap and seal joints. Lap film a minimum of 6" at joints with top lap placed in direction of spreading of concrete. Seal joints watertight by taping or applying sealant at overlapping edges and ends.
   3. Carry film up walls, columns, etc. and secure in place with cement or tape. Fold and cement corners or otherwise make vaporproof.
   4. Provide sealed contact with piping and other penetrating items. Cut film carefully around opening for pipes, ducts, conduit, wiring, etc. Tape film to insure maximum barrier effectiveness.
   5. Exercise care so that film is not punctured. Seal joints, cuts, punctures, etc. with tape, cement or hot iron.
   6. Trim exposed film at floor line after concrete has cured and hardened.
   7. Repair vapor retarder damaged during placement of concrete reinforcing.

G. Provide sufficient workmen to allow for placement of concrete and other operations within time limits required.

H. Keep delivery carts and buggies on runways. Do not allow them to bear on reinforcing or uncured concrete.

I. Deposit concrete within 6 feet of its final location to avoid segregation due to rehandling or flowing. Do not drop concrete freely where reinforcing will cause segregation. Chuting procedure is subject to approval of Owner's Engineer. Maximum allowable drop is 5 feet. SPREADING WITH VIBRATORS IS PROHIBITED.

J. Place concrete quickly and vibrate thoroughly with a vibratory screed or other device approved by Owner's Engineer. Maintain specified position of mesh and reinforcement. Follow ACI 309 for use and type of vibrators.

K. Deposit concrete continuously, or when continuous placement is not possible, provide construction joints at locations approved by Owner's Engineer.

L. Do not deposit partially set concrete, retempered concrete or any concrete failing slump or air content tests.

M. Consolidate concrete by internal vibration to maximum practical density so that it is free from pockets of coarse aggregate and trapped air, fits tightly against subgrades, forms and embedded items and leaves smooth, dense surfaces.

N. Operate vibrators using experienced workers and where possible use same operators throughout Project. DO NOT USE VIBRATORS AGAINST FORMS OR REINFORCEMENT.

O. Finishes: Follow ACI 301 (Chapter 11). Perform finishing using only experienced, skilled workers.
1. Flatwork:
a. Slab finish shall be as noted on structural foundation plans. Reference structural general notes for flatness requirements pertaining to surface finish.
b. Detectable Warning Finish: For exterior handicapped curb cuts (ramp only not on flared sides), textured or imprinted concrete using rollers or aluminum tools to produce 0.9" diameter x 0.2" high (nominal) truncated domes at 2.35" on center following requirements of Americans With Disabilities Act (ADA).
2. Vertical and Miscellaneous Work:
a. Exposed Surfaces: Smooth, Do Not Rub Cement Paste on Exposed Concrete Surfaces.
b. Concealed Surfaces: Rough form finish.

P. Control (Contraction) Joints:
1. General Requirements:
a. Provide joints in walks, pads, slabs and toppings shown or specified.
b. Make joints approximately 1/8" wide and minimum depth of 1/4 slab thickness.
c. Locate as shown or as follows if not shown. Verify final locations with Owner's Engineer before proceeding.

2. Interior Locations:
a. Provide sawed control joints where shown or at maximum 20 feet on center in each direction in slabs and toppings if not shown.
V. Install sawed joints immediately after final finishing to depth of 1-1/2" with Soff-Cut saw.
VI. Saw control joints 1/8" wide unless otherwise approved. A keyed construction joint may be located where sawed joint is required.

Q. Curing and Protection: Follow ACI 308.
1. Prevent excessive moisture loss from formed surfaces. Cure formed surfaces by moist-curing or application of curing compound for remainder of curing period if forms are removed before 7 days have elapsed.
2. Provide 1 application of liquid curing/sealer compound immediately after finishing of concrete on interior and exterior concrete slabs.
a. Exception #1: Floors scheduled to receive ceramic tile and quarry tile shall be sheet membrane/water (moist) cured for minimum of 10 days.
1) Begin water curing as soon as concrete has hardened sufficiently to prevent damage from water or cover material.
2) Water curing shall consist of ponding or with sprinkling, spraying or covering with wet burlap, sand or waterproof barrier such as polyethylene or building paper.

3) Maintain 100% coverage continuously over water cured slabs for minimum of 4 days for ponding and for 7 days for spraying and membrane curing.

3.04 FIELD QUALITY CONTROL

A. Test and inspect materials and operations as Work progresses. Failure to detect defective Work shall not prevent rejection when defect is discovered nor shall it obligate Owner for final acceptance.

B. Costs for any retesting resulting from Work found to be in non-compliance shall be paid for by Contractor.

C. Strength: ASTM C31, C39 and C172.
1. Conduct strength tests of all classes of concrete (except miscellaneous mixes).
2. Secure composite samples following ASTM C172. For strength tests, a sample shall be obtained from same batch of concrete on a representative, random basis. A sample consists of six specimens.
3. Mold and cure each sample following ASTM C31.
4. Test 1 specimen at 7 days, test 2 specimens at 28 days and 1 specimen at 56 days following ASTM C39. Results shall be average of strengths of 2 specimens, except that if 1 specimen in a test manifests evidence of improper sampling, molding or testing, it shall be discarded.
5. Record exact location of Work represented by each sample on test reports.
6. Provide a sample for each amount or fraction thereof of each class of concrete placed each day as follows:
   a. 0-150 Cubic Yards: 1 Sample.

E. Air Content: ASTM C231.

F. Slump: ASTM C143.

3.05 ADJUSTING AND CLEANING

A. Provide materials, methods and finishes for cleaning, patching and other repairs consistent with similar concrete Work in place, approved by Owner's Engineer before beginning repair Work and performed at Contractor's expense.

B. Repair any slabs which do not meet finish requirements performing all grinding, filling of cracks or patching and leveling procedures as required. Replace slabs which cannot be successfully repaired.

C. Point carefully around piping, conduit and other penetrations on both interior and exterior surfaces.

D. Obtain Owner's Engineer prior approval of any corrective measures for slabs which are dusting or showing other signs of improper curing. These may include additional applications of sealer or hardener, grinding or covering with coating or topping.

E. Remove from interior and exterior exposed surfaces any stain-producing elements such as pyrites, nails, wire, reinforcing steel and form ties immediately prior to final acceptance.

F. Remove stains completely. Use of weak acids or patented cleaners is acceptable but surface is to be completely neutralized after use.

G. Blend in surfaces of exposed repairs inconspicuously with surrounding surfaces.

3.06 PROTECTION

A. Protect newly placed concrete from weather and construction traffic damage.

3.07 SPECIAL PROCEDURES

A. It is Project intent to continue concrete Work required to keep Project on schedule throughout summer and winter.

B. Hot Weather Concreting:
1. Follow ACI 305R.
2. Obtain approval to use a retarder in concrete.
3. Temperature of concrete shall not exceed 95^{o}F.
4. Cool water and aggregate to lower temperature of concrete.
5. Cool subgrade and forms by sprinklering with water immediately before placing.
6. Schedule trucks to reduce waiting time at Site.
7. Cure immediately after finishing.

C. Replace any concrete injured or destroyed by reason of freezing, hot or cold weather at Contractor's own expense including cost of replacing any Work embedded in concrete.

END OF SECTION 03300

SECTION 04200 - UNIT MASONRY

PART 1 - GENERAL

RELATED DOCUMENTS:
Drawings and general provisions of Contract, including General and supplementary Conditions and Division-1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Extent of each type of masonry work is indicated on drawings and schedule.

QUALITY ASSURANCE:

Field Constructed Mock Ups: Prior to installation of masonry work, erect sample wall representative of completed masonry work required for project with respect to qualities of appearance, materials and construction. Locate mock-ups on site in locations indicated or, if not indicated, as directed by Architect. Retain mock-ups during construction as standard for judging completed masonry work. For the following types of masonry, build mock-ups which are approximately 4' long by 4' high by full thickness including back-up wythes. When directed, demolish mock-up and remove from site.

Each type of exposed unit masonry work.

SUBMITTALS:

Product Data: Submit manufacturer's product data for each type of masonry unit, accessory, and other manufactured products, including certifications each type complies with specified requirements.

Samples: Submit, for verification purposes, samples of each exposed masonry unit and colored masonry mortar, if any. Include in each set of samples the full range of exposed colors and textures to be expected in completed work.

JOB CONDITIONS:
Protection of Work: During erection, cover top of walls with heavy waterproof sheeting at end of each days' work. Cover partially completed structures when work is not in progress.

Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

Do not apply uniform floor or roof loading for at least 12 hours after building masonry walls or columns.

Do not apply concentrated loads for at least 3 days after building masonry walls or columns.

Staining: Prevent grout or mortar or soil from staining the face of masonry to be left exposed or painted. Remove immediately grout or mortar in contact with such masonry.

Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.

Protect sills, ledges and projections from droppings of mortar.

Cold Weather Protection:

Do not lay masonry units which are wet or frozen or when temperature is 45 Degrees F and falling.

Protect completed masonry and masonry not being worked on in the following manner. Temperature ranges indicated apply to mean daily air temperatures except for grouted masonry. For grouted masonry temperature ranges apply to anticipated minimum night temperatures.

40 F (4 deg. C) to 32 deg. F (0 deg. C):

Protect masonry from rain or snow for at least 24 hours by covering with weather-resistive membrane.

32 F (0 deg. C) to 20 deg. F (-7 deg. C):

Completely cover masonry with weather-resistive insulating blankets or similar protection for at least 24 hours, 48 hours for grouted masonry.

20 deg. F (-7 deg. C) and below:

Except as otherwise indicated, maintain masonry temperature above 32 F (0 deg) for 24 hours using enclosures and supplementary heat, electric heating blankets, infrared lamps or other methods proven to be satisfactory. For grouted masonry maintain heated enclosure to 40 deg. F (4 deg. C) for 48 hours.

PART 2 – PRODUCTS

ACCEPTABLE MANUFACTURERS:
Acme Brick
Forterra – Texas Collection

MASONRY UNITS, GENERAL:
Manufacturer, obtain masonry units from one manufacturer, of uniform texture and color for each kind required, for each continuous area and visually related areas. All units shall be made in the USA.

Masonry Unit Characteristics: Provide units complying with standards referenced and requirements indicated.

Manufacturer, obtain masonry units from one manufacturer, of uniform texture and color for each kind required, for each continuous area and visually related areas. All units shall be made in the USA.

Masonry Unit Characteristics: Provide units complying with standards referenced and requirements indicated.

BRICK:
Size: Unless otherwise indicated, provide bricks manufactured to the following actual dimensions:

Basis of Design: Acme Brick
King Size, Velour Texture - 3" x 3" x “10 - allow up to two (2) brick types.
Color: Blend 215 “Moffat” (Field) Brick #1
Blend 206 “Desert Tan” (Accent) Brick #2

Provide special molded shapes where indicated and for application requiring brick of form, size and finish on exposed surfaces which cannot be produced from standard brick sizes by sawing.

For sills, caps and similar applications resulting in exposure of brick surfaces which otherwise would be concealed from view, provide un-cored or un-frogged units with all exposed surfaces finished.

Facing Brick (FogBrk): U.S. Made ASTM C 216, and as follows:

Grade SW

Grade MW, except Grade SW, where indicated by ASTM C 216 grade requirements for applicable weathering index and exposure.

Type FBS (normal size and color variations)

Application: Use where brick is exposed, unless otherwise indicated.

Texture and Color:
Two colors
Little range, no blends.

CONCRETE MASONRY UNITS (CMU):
Size: U. S. Made. Manufacturer's standard units with nominal face dimensions of 16" long x 8" (15-5/8" x 7-5/8" actual), unless otherwise indicated.

GROUND-FACE CONCRETE MASONRY UNITS

A. Ground-face concrete masonry units shall be made from natural and manufactured aggregates, cement and color. All of these materials are derived from nature and will vary in uniformity of size, shape, and texture and particle color. The manufacturer shall exercise reasonable care in the manufacturing process to minimize these variations in size, shape, texture and particle color so that completed product will match approved samples and mockup. Some variation in color and texture will be acceptable to the extent the approved samples and mockup exhibit variation. Edge and corner chips will be acceptable to the extent ASTM C90, paragraph 7.2.1 allows chips and cracks.
B. Basis of Design: Provide Hill Country Stone as manufactured by Featherlite Building Products, 508 McNeil Road, Round Rock, Texas 78681 (512) 255-2573.
    1. All ground faces shall have a factory-applied coating of clear, VOC-compliant acrylic sealer.

2. Provide special shapes for lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.

3. Provide bull-nose/square-edged/chamfered units for outside corners, as indicated on plans.

4. All ground-face units shall be manufactured with integral water repellent “Dry-Block” as manufactured by Grace Construction Products.

5. Comply with ASTM C90 or C 129 and as follows:

a. Unit compressive strength:

1) ASTM C90 1,900 psi

2) ASTM C129 600 psi

b. Weight classification: light weight or medium weight depending on color selection.

c. Size: Manufactured to the dimensions indicated on drawings within tolerances specified in ASTM C90, except that grinding removes approximately 1/16” additional per face.

d. Finish: Exposed faces of ground-face units shall match color, pattern, and texture of architect’s submittal selection.

C. Ground-face Concrete Masonry Cleaner: Clean ground-face masonry using Burnished Custom Masonry Cleaner as manufactured by ProSoCo, Inc. Follow ProSoCo’s product data instructions for proper application. No other cleaning agents may be used without specific written approval of Architect.

MORTAR MATERIALS:
Portland Cement: ASTM C 150, Type I. Provide natural color or as required to produce required mortar color.

MASONRY CEMENT: ASTM C91

Hydrated Lime: ASTM C 207, Type S.

Aggregate for Mortar: ASTM C 144, except for joints less than 1/4" use aggregate graded with 100% passing the No. 16 sieve.

Aggregate for Grout: ASTM C 404.

Water: Clean and potable.

MASONRY ACCESSORIES:
Horizontal Joint Reinforcing and Ties for Masonry:

Provide welded wire units prefabricated in straight lengths of not less than 10', with matching corner ("L") and intersecting ("T") units. Fabricate from cold-drawn steel wire complying with ASTM A 82, with deformed continuous side rods and plain cross rods, into units with widths of approximately 2" less than nominal width of walls and partitions as required to position side rods for full embedment in mortar with mortar coverage of not less than 5/8" on joint faces exposed to exterior and not less than 1/2" elsewhere. Provide the following type of joint reinforcing unless otherwise indicated.

Coated or corrosion-resistant metal meeting or exceeding applicable standard:

Zinc-coating flat metal: ASTM A153
Zinc-coating of wire: Hot Dipped Galvanized
Provide job fabricated corner sections for all type of reinforcement.

Types: Wire Mesh:
Minimum Gage: 20
Mesh: 1/2 inch
Galvanized Wire:
Width: 1 inch less than width of masonry

Wall Reinforcement:
Wire Gage: 9 gage (side and cross rods) cross rods not more than 16" o.c.
Types: Truss
Provide with "V" drip.

Anchors and Ties:

Provide straps, bars, bolts and rods fabricated from 1/4" diameter rod stock, unless otherwise indicated
Paint all welds with red primer.

Flexible Anchors: Where masonry is indicated to be anchored to structural framework with flexible anchors, provide 2-piece anchors which will permit horizontal and vertical movement of masonry but will provide lateral restraint.

Adjustable Wire Anchors:

Wire Anchors: Hohmann & Barnard 14 ga. DW-10 with Hot dipped Galvanized Finish

Wire: All wire to meet ASTM A82 for steel wire.

Triangular Wire Loops: Vee Byna-Tie 3/16” Diam (Standard). Length as on drawings or as required by manufacturer for proper anchoring.

For interior work, including devices which extend only into interior wythes of exterior masonry, fabricate from steel with mill galvanized.

For devices which extend into exterior wythe, fabricate from steel with hot-dip galvanized coating, ASTM A 153, Class B-2.

Flashings for Masonry:
Provide concealed flashing, where noted on construction documents.

Virgin polyvinyl chloride with plasticizers and other modifiers, formed into uniform flexible sheets not less than 40-mils thick and black in color, unless otherwise indicated.
Henry – Blueskin TWF
Grace - Vycor

MISCELLANEOUS MASONRY ACCESSORIES:
Reinforcing Bars: Deformed steel, ASTM A 615, Grade 60 for bars No3" x 3" x “10. 3 to No. 18.

Bond Breaker Strips: 15-lb. Asphalt roofing felt complying with ASTM D 226, or 15-lb, coal-tar roofing felt complying with ASTM D 227.

Pre-molded Control Joint Strips: Solid rubber strips with a Shore A durometer hardness of 60 to 80, designed to fit standard sash block and maintain lateral stability in masonry wall; size and configuration as indicated.

Plastic Weep holes: Equal to Hohmann & Barnard QV-Quadro-Vent – Clear.

Mortar Net – Equal to Hohmann & Barnard 1" thick Mortar Trap Mesh.

MORTAR AND GROUT MIXES:
Do not lower the freezing point of mortar by use of admixtures or anti-freeze agents.

Masonry Cement - Must comply with ASTM C91.

Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification, for types of mortar required, unless otherwise indicated.

Use Type S mortar for reinforced masonry and where indicated.

Use Type N mortar for exterior, above grade load bearing and non-load bearing walls; for interior load bearing walls; and for other applications where another type is not indicated.

Grout for Unit Masonry: Comply with ASTM C 476 for grout for use in construction of reinforced and non-reinforced unit masonry. Use grout of consistency indicated or if not otherwise indicated, of consistency (fine or coarse) at time of placement which will completely fill all spaces intended to receive grout.

PART 3 - EXECUTION

INSTALLATION, GENERAL:
Thickness: Build masonry construction to the full thickness shown, except, build single-wythe walls (if any) to the actual thickness of the masonry units, using units of nominal thickness shown or specified.

Build chases and recesses as shown and as required for the work of other trades. Provide not less than 8" of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.

Cut masonry units with motor-driven saws to provide clean, sharp, un-chipped edges. Cut units as required to provide pattern shown and to fit adjoining work neatly. Use full units without cutting where possible. Use dry cutting saws to cut concrete masonry units.

Chipped block shall not be used where visible.

Do not wet concrete masonry units.

Pattern Bond: Lay exposed masonry in the bond pattern shown, or if not on, lay in running bond vertical joint in each course centered on units in courses above and below.

Lay concealed masonry with all units in a wythe bonded by lapping not less than 2". Bond and unlock each course of each wythe at corners, unless otherwise shown.

Layout walls in advance for accurate spacing of surface bond patterns, with uniform joint widths and to accurately locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half size units at corners, jambs and wherever possible at other locations.

Lay-up walls plumb and with courses level, accurately spaced and coordinated with other work.

Lay-up walls: Lay up walls with the good side of the units towards the hallways or larger walls.

Stopping and Resuming Work: Rack back 1/2-masonry unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if required) and remove loose masonry units and mortar prior to laying fresh masonry.

Built-In Work: As the work progresses, build-in items specified under this and other sections of these specifications. Fill in solidly with masonry around built-in items.

Fill space between hollow metal frames and masonry solidly with mortar.

Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

Fill CMU cores with grout 3 courses (24") under bearing plates, beams, lintels, posts and similar conditions, unless otherwise indicated.

Intersecting Load bearing Walls: If carried up separately, block vertical joint with 8" maximum offsets and provide rigid steel anchors spaced not more than 4'-0" o.c. vertically, or omit blocking and provide rigid steel anchors at not more than 2'-0" o.c. vertically. Form anchors of galvanized steel not less than 1-1/2" x 1/4" x 2'-0" long with ends turned up not less than 2" or with cross-pins. If used with hollow masonry units, embed ends in mortar filled cores.

Non-Load bearing Interior Partition Walls: Build full height of story to underside of solid structure above, unless otherwise indicated.

MORTAR BEDDING AND JOINTING:
Lay brick and solid concrete masonry units with completely filled bed, head and collar joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.

Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and foundation walls and in all courses of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or filled with concrete or grout. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.

Joints: Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not otherwise indicated, lay walls with 3/8" joints.

Cut joints flush for masonry walls which are to be concealed or to be covered by other materials.

Tool horizontal joints with a 2'-0" or 3'-0" sledge runner. All joints to be uniform.

Tool exposed joints slightly concave using a jointer larger than joint thickness. Tool horizontal joint with a 2' - 3' sledge runner, all joints shall be uniform. Rake out mortar in preparation for application of caulking or sealants where shown.

Remove masonry units disturbed after laying; clean and relay in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar, and reset in fresh mortar.

CAVITY WALLS:
Keep cavity clean of mortar droppings and other materials during construction. Strike joints facing cavity, flush.

Tie exterior wythe to back with continuous horizontal joint reinforcing embedded in mortar joints at not more than 16" o.c. vertically.

Provide weep holes in exterior wythe of cavity, composite and veneer walls located immediately above ledges and flashing, spaced 2' -0 " o.c., unless otherwise indicated.

HORIZONTAL JOINT REINFORCING:
Provide continuous horizontal joint reinforcing as shown and specified. Fully embed longitudinal side rods in mortar for their entire length with a minimum cover of 5/8" on exterior side of walls, 1/2" at other locations. Lap reinforcement a minimum of 6".

Do not bridge control and expansion joints with reinforcing, unless otherwise indicated. Provide continuity at corners and wall intersections by use of job fabricated "L" and "T" sections. Cut and bend units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.

Space continuous horizontal reinforcement as follows:

For multi-wythe walls (solid or cavity) where continuous horizontal reinforcing acts as structural bond or tie between wythe, space reinforcing as required by code but not less than 16" o.c. vertically.

For single-wythe walls, space reinforcing at 16" o.c. vertically, unless otherwise indicated.

Reinforce masonry openings greater than 1'-0" wide, with horizontal joint reinforcement placed in 2 horizontal joints approximately 8" apart, immediately above the lintel and immediately below the sill. Extend reinforcement a minimum of 2'-0" beyond jambs of the opening, bridging control joints, where provided.

ANCHORING MASONRY WORK:

Provide anchor devices of type indicated. If not indicated, provide standard type for facing and back-up involved.

Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

Provide an open space not less than 1” in width between masonry and structural member, unless otherwise indicated.
Keep open space free of mortar or other rigid materials.

Anchor masonry to structural members with metal ties embedded in masonry joints and attached to structure. Provide anchors with flexible ties sections, unless otherwise indicated.

Space anchors as indicated, but not more than 24” o.c. vertically and 36" o.c. horizontally.

Anchor single wythe masonry veneer to backing with metal ties as follows:

Anchor veneer to structural members with metal anchors embedded in masonry joints and attached to structure. Provide anchors with flexible tie section, unless otherwise indicated.

Space veneer anchors as shown, or if not shown, space not more than 16" o.c. vertically and 24" o.c. horizontally. Provide additional anchors within 1 - 0" of openings and space not more than 3 - 0" around perimeter.

LINTELS:
Install loose lintels of hot-dipped galvanized steel and other materials where shown.

Provide masonry lintels where shown and wherever openings of more than 1' 0" are shown without structural steel or other supporting lintels. Provide precast or formed-in-place masonry lintels. Thoroughly cure precast lintels before handling and installation. Temporarily support formed in place lintels.

For hollow concrete masonry unit walls, use specially formed "U" shaped lintel units with reinforcing bars placed as shown and filled with grout of consistency required to completely fill space between reinforcing bars and masonry unit.

Provide minimum bearing at each jamb, of 4" for openings less than 6' 0" wide, and 8" for wider openings.

CONTROL AND EXPANSION JOINTS:
Provide vertical and horizontal expansion, control and isolation joints in masonry where shown. Build-in related masonry accessory items as the masonry work progresses. Space joints a maximum of 20 feet (exterior walls) and 30 feet (interior walls) unless otherwise shown on Drawings.

See Division 7 Sections for "Joint Sealers".

Build in joint fillers where shown, specified in a Division 7 section "Joint Sealers". Joint width for sealants: 3/8" unless otherwise indicated.

FLASHING OF MASONRY WORK:
Provide concealed flashings in masonry work at, or above, all shelf angles, lintels, ledges and other obstructions to the downward flow of water in the wall so as to divert such water to the exterior. Prepare masonry surfaces smooth and free from projections which could puncture flashing. Place through-wall flashing on bed of mortar and cover with mortar. Seal penetrations in flashing with mastic before covering with mortar.

Extend flashings the full length of lintels and shelf angles and minimum of 4” into masonry each end. Extend flashing from a line 1/2" in from exterior face of outer wythe of masonry, through the outer wythe, turned up a minimum of 4", and through the inner wythe to within 1/2" of the interior face of the wall in exposed work. Where interior surface of inner wythe is concealed by furring, carry flashing completely through the inner wythe and turn up approximately 2". At heads and sills turn up ends not less than 2" to form a pan.

Provide weep holes in the head joints of the same course of masonry bedded in the flashing mortar.

Interlock end joints of deformed metal flashings by overlapping deformations not less than 1-1/2" and seal lap with elastic sealant.

Install flashing in accordance with manufacturer's instructions.

Install reglets and nailers for flashing and other related work where shown to be built into masonry work.

REPAIR, POINTING AND CLEANING:
Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended.

Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints including corners, openings and adjacent work to provide a neat, uniform appearance, prepared for application of caulking or sealant compounds.

Clean exposed brick masonry surfaces by the bucket and brush hand cleaning method or by high pressure water method. Comply with requirements of BIA Techanical Notes No. 20 "Cleaning Brick Masonry."

Use commercial cleaning agents in accordance with manufacturer’s instructions.

Clean exposed CMU masonry by dry brushing at the end of each day's work and after final pointing to remove mortar spots and droppings. Comply with recommendations in NCMA TECK Bulletin No. 28.

END OF SECTION 04200

SECTION 05120 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes structural steel and grout.

1.2 ALLOWANCE

A. Include in bid a lump sum allowance for additional structural steel materials (fabricated and installed) required to complete the Work equal to 3.0 tons of structural steel. Any unused tonnage will be credited to Owner at a cost of $4,000.00 per ton.

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Submit shop drawings of all structural steel members. Provide electronic (PDF) copies of each drawing. Shop drawings shall include fabrication piece drawings and field erection drawings. Structural construction drawings shall not be photocopied and submitted.

1.5 INFORMATIONAL SUBMITTALS

A. Provide electronic (PDF) copies of all required submittal information.

1. Qualification Data: For qualified Installer and fabricator.
2. Welding certificates.
3. Mill test reports for structural steel, including chemical and physical properties.
4. Source quality-control reports.

1.6 QUALITY ASSURANCE

A. Erector Qualifications: A qualified erector who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE. In lieu of AISC certification, erector may, at the construction manager’s recommendation and request, provide an in-house quality control program indicating compliance with minimum steel erection quality control

requirements noted in AISC 360 – 10 “Specification for Structural Steel Buildings”, Chapter N, subsection N2.

B. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, under Building QMS Certification Program, Category BU. In lieu of AISC certification, fabricator may, at the construction manager’s recommendation and request, provide an in-house quality control program indicating compliance with quality control procedures meeting minimum fabrication requirements noted in AISC 360 – 10 “Specification for Structural Steel Buildings”, Chapter N, subsection N2.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Comply with applicable provisions of the following specifications and documents:

1. AISC 303, Code of Standard Practice for Steel Buildings and Bridges.
2. AISC 360, Specification For Structural Steel Buildings.
3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
4. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design."

E. Preinstallation Conference: Conduct conference at Project site.

1.7 FABRICATION

A. Fabricate structural steel according to AISC specifications and tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.

B. Shop Priming: Prepare surfaces according to SSPC-SP 2 or SSPC-SP 3. Shop prime steel to a dry film thickness of at least 1.5 mils. Do not prime surfaces to be embedded in concrete or mortar or to be field welded.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 572/A 572M, Grade 50 (345), Fy = 50 KSI.

B. Plate, Bar, Channels, Angles Shapes: ASTM A 36/A 36M, Fy = 36 KSI.

C. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing, Fy = 46 KSI.

D. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, Fy = 35 KSI.

E. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.

B. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.

1. Finish: Plain.

C. Threaded Rods: ASTM A 36/A 36M.

1. Finish: Plain.

D. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

2.3 PRIMER

A. Low-Emitting Materials: Paints and coatings 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. Primer: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

C. Primer: SSPC-Paint 25, Type I, zinc oxide, alkyd, linseed oil primer.

2.4 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.

B. Fabrication shop shall have a minimum of three years experience in the field of steel fabrication. Steel erector shall have same minimum experience.

C. General: Shear and punch metals cleanly and accurately. Remove burrs and ease exposed edges. Form bent-metal corners to smallest radius possible without impairing work.

D. Fabricate steel pipe columns with steel top plates drilled for connection bolts and welded to pipe with continuous fillet weld same size as pipe wall thickness.

1. Provide base plates as scheduled on construction documents.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.8 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Base Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

2. Joint Type (Pre-Engineered Frame): Bolted moment connection (turn-of-nut method)

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.

1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 05120

SECTION 05210 - STEEL JOISTS

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. K-series steel joists.
2. KCS-type K-series steel joists.
3. K-series steel joist substitutes.
4. Joist accessories.

1.3 DEFINITIONS

A. SJI "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.

B. Design special joists to withstand design loads with live load deflections no greater than the following:

1. Floor Joists: Total Vertical deflection of 1/240 of the span.
2. Roof Joists: Total Vertical deflection of 1/240 of the span.

1.5 SUBMITTALS

A. Product Data: For each type of joist, accessory, and product indicated.

B. Shop Drawings: Show layout, designation, number, type, location, and spacings of joists. Include joining and anchorage details, bracing, bridging, joist accessories; splice and connection locations and details; and attachments to other construction.

1. Indicate locations and details of bearing plates to be embedded in other construction.
2. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.
3. Sealed joist calculations for each joist layout, type, and span, and loading condition.

C. Welding certificates.

D. Manufacturer Certificates: Signed by manufacturers certifying that joists comply with requirements.

E. Mill Certificates: Signed by bolt manufacturers certifying that bolts comply with requirements.

F. Qualification Data: For manufacturer.

G. Field quality-control test and inspection reports.

H. Research/Evaluation Reports: For joists.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables of SJI "Specifications."

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. SJI Specifications: Comply with standard specifications in SJI's "Specifications" that are applicable to types of joists indicated.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel: Comply with SJI's "Specifications" for web and steel-angle chord members.

B. Steel Bearing Plates: ASTM A 36/A 36M.

C. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.

1. Finish: Plain, uncoated.

D. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.

1. Finish: Plain.

E. Welding Electrodes: Comply with AWS standards.

2.2 PRIMERS

A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

B. Primer: Provide shop primer that complies with Division 9 painting Sections.

2.3 K-SERIES STEEL JOISTS

A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.

1. Joist Type: K-series steel joists and KCS-type K-series steel joists.

B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.

C. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

D. Provide holes in chord members for connecting and securing other construction to joists.

E. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."

F. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."

G. Camber joists according to SJI's "Specifications."

H. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

2.4 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications." Furnish additional erection bridging if required for stability.

C. Bridging: Fabricate as indicated and according to SJI's "Specifications." Furnish additional erection bridging if required for stability.

D. Fabricate steel bearing plates with integral anchorages of sizes and thicknesses indicated. Shop prime paint.

E. Steel bearing plates with integral anchorages are specified in Division 5 Section "Metal Fabrications."

F. Supply ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch (13 mm) of finished wall surface, unless otherwise indicated.

G. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.5 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3, as deemed necessary by the joist manufacturer’s paint and primer requirements.

B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.

C. Apply 1 coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil (0.025 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads have been applied.

C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using carbon-steel bolts.

E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.

F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.

B. Field welds will be visually inspected according to AWS D1.1/D1.1M.

C. In addition to visual inspection, field welds will be tested according to AWS D1.1/D1.1M and the following procedures, as applicable:

1. Radiographic Testing: ASTM E 94.
2. Magnetic Particle Inspection: ASTM E 709.
3. Ultrasonic Testing: ASTM E 164.
4. Liquid Penetrant Inspection: ASTM E 165.

D. Bolted connections will be visually inspected.

E. High-strength, field-bolted connections will be tested and verified according to procedures in RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts."

F. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.

G. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

3.4 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.

1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 05210

SECTION 05310 - STEEL DECK

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data & Shop Drawings.

B. Comply with SDI Publication No. 29, "Specifications and Commentary for Steel Roof Deck

C. Comply with AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

PART 2 - PRODUCTS

2.1 MATERIALS

A. Galvanized Steel Sheet: ASTM A 653 structural steel, and as follows:

1. Zinc-Coating Weight: G60 MIN.

2.2 DECKING

A. Roof Deck: Fabricate panels from galvanized steel sheet without top-flange stiffening grooves and as follows:

1. Deck Profile: Type 1.5 B, wide rib.
2. Profile Depth: 1.1/2 inch
3. Design Uncoated Steel Thickness: 22 GA (0.0295 inch)
4. Grade: Fy = 33 KSI

B. Floor Deck: Fabricate panels from galvanized steel sheet without to flange stiffening grooves as follows:
1. Deck Profile: 0.6 C
2. Profile Depth: 9/16 inch
3. Design Uncoated Steel Thickness: 28 GA (0.0149 inch)
4. Grade: Fy = 60KSI

C. Sheet Metal Accessories: ASTM A653, galvanized, unless noted otherwise. Provide accessories of every kind required to complete the installation of metal decking in the system shown. Finish sheet metal items to match deck including, but not limited to, the following items:

1. Metal Cover Plates: For end-abutting deck units, to close gaps at changes in deck direction, columns, walls and openings. Same quality as deck units but not less than 1.3 mm (18 gauge) sheet steel.
2. Continuous sheet metal edging: at openings and concrete slab edges. Same quality as deck units but not less than 1.3 mm (18 gauge) steel.

Side and end closures supporting concrete and their attachment to supporting steel shall be designed by the manufacturer to safely support the wet weight of concrete and construction loads. The deflection of cantilever closures shall be limited to 3 mm (1/8 inch) maximum.

3. Metal Closure Strips: For openings between decking and other construction, of not less than 1.3 mm (18 gauge) sheet steel of the same quality as the deck units. Form to the configuration required to provide tight-fitting closures at open ends of flutes and sides of decking.

2.3 MISCELLANEOUS

A. Accessories: Manufacturer's recommended roof deck accessory materials

B. Submit shop drawings indicating roof deck material, gage, and finish. Shop drawings shall provide deck sheet lengths and attachment weld patterns and side lap fastener requirements.

PART 3 - EXECUTION

3.1 DECK INSTALLATION

A. Install 1.5 B, 22 gage roof deck panels and accessories according to SDI Publication No. 29. Using 5/8” puddle welds and #10 Tek side lap fasteners. Reference plans for fastening pattern. Fasten deck to perimeter angle using 5/8” weld at 6” o/c.

B. Install 0.6C 28 GA floor deck panels and accessories according to manufacturer’s recommendations. Using 5/8” paddle welds (weld washers required). Reference plans for fastening patterns.

C. Place, adjust, align, and bear deck panels on structure. Do not stretch or contract side lap interlocks.

D. Place deck panels flat and square and weld to structure without warp or deflection.

E. Cut, reinforce, and fit deck panels and accessories around openings and projections as required in structural drawings.

F. Roof Deck Accessories: Install sump pans, sump plates, ridge and valley plates, finish strips, cover plates, end closures, and reinforcing channels. Weld to substrate.

G. Weld shear connectors through deck to structure.

H. Prepare and repair damaged galvanized coatings on both surfaces as required in structural drawings.

I. Wire brush, clean, and paint scarred areas, welds, and rust spots on both surfaces of painted deck panels.

END OF SECTION 05310

SECTION 05400 - 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 Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Exterior non-load-bearing wall framing.
   2. Soffit Framing.
   3. Ceiling joist framing.

B. Related Sections include the following:

   1. Division 05 Section "Metal Fabrications" for masonry shelf angles and connections.
   2. Division 09 Section "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.
   3. Division 09 Section "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.

1.3 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated in the drawings including mechanical fasteners, reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

B. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:

   1. Steel sheet.
   2. Expansion anchors.
   3. Power-actuated anchors.
   4. Mechanical fasteners.
   5. Vertical deflection clips.
   6. Miscellaneous structural clips and accessories.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.

C. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

D. Comply with AISI's "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, 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 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following:
1. Clark Dietrich Building Systems.
2. Consolidated Fabricators Corp.; Building Products Division.
3. The Steel Network, Inc.

C. Basis-of-Design Product: The design for connector devices is based on Clark Dietrich, Inc. as indicated in other Part 2 Articles.

2.2 MATERIALS

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: ST33H for 18 gage studs and thinner and ST50H for 16 gage studs and thicker.
2. Coating: G60 .

B. Steel Sheet for Vertical Deflection and Miscellaneous Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: 50, Class 1 or 2.
2. Coating: G90 .

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0451 inch .
2. Flange Width: 1-5/8 inches
3. Section Properties: 6" Studs minimum $I_x = 2.32\ in^4$; $S_x = 0.772\ in^3$

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches.

C. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web. Mechanical attachment to structure and screw attachment to stud web using step-bushings to permit frictionless vertical movement; 68 mils minimum thickness, size as required by structural design calculations. Use only vertical deflection connection products that have a valid ICC ES Report complying with ICC Acceptance Criteria AC261, such as ICC-ESR-1903 or equivalent.

1. Basis-of-Design Product: Clark Dietrich, Inc.

    a. Exterior Side of Wall: Clark Dietrich, Inc. Fast Clip Side Clip (FCSC 5.12")
    b. Exterior Head of Wall: Clark Dietrich, Inc. Fast Top Clip (FTC).
    c. Non Deflection Clips: Clark Dietrich, Inc. Uni-Clip End Clip (UCEC).

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 manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

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, knee braces, and girts.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.5 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Cold-Formed Steel Connections: ASTM 653/A653, zinc coated by hot-dip process according to ASTM A123/A 123M.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

D. Power-Actuated Anchors: Shall be Hilti x-u (Dia=0.157”) with minimum concrete embedment of 1-1/4” and full penetration into steel. Reference drawings for spacing and edge distances.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 .

B. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

2.7 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed metal framing members by screw fastening standard with fabricator. Wire tying of framing members is not permitted.
   a. Locate mechanical fasteners and install according to manufacturer’s instructions, with screw penetrating joined members by not less than three exposed screw threads.

4. Fasten other materials to cold-formed metal framing by screw fastening according to manufacturer’s instructions.

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 and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

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.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

B. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by screw fastening. Wire tying of framing members is not permitted.
    a. Locate mechanical fasteners and install according to manufacturer's instructions, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

H. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to bottom track, unless otherwise indicated. Install built up stud jambs at window and door openings and other locations as indicated on structural drawings. Space studs as follows:

1. Stud Spacing: 16 inches or as indicated on structural drawings for special conditions.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
1. Mechanically fasten vertical deflection clips to infill studs and anchor to building structure.

E. Install horizontal bridging in curtain-wall studs, spaced in rows indicated on Drawings but not more than 48 inches apart. Fasten at each stud intersection.
1. Bridging: Cold-rolled steel channel, continuously inserted through punched web of stud and mechanically fastened to the web of each stud.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.5 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05400

SECTION 05500 - METAL FABRICATIONS

PART 1 - GENERAL

RELATED DOCUMENTS:
Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

SUMMARY

This section includes the following metal fabrications:

- Lintels
- Trench Grate Covers
- Toilet Partitions
- Floor Trough
- Knox Box

Miscellaneous framing and supports for the following:

Related Sections: The following sections contain requirements that relate to this section.

DEFINITIONS

SUBMITTALS:

General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

Product Data: for products used in miscellaneous metal fabrications, including paint products and grout.

Shop Drawings: Submit shop drawings for fabrication and erection of miscellaneous metal fabrications. Include plans, elevations and details of sections and connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation by other sections.

Samples: representative of materials and finished products as may be requested by Architect.

QUALITY ASSURANCE

Fabricator Qualifications: Firm experienced in successfully producing metal fabrications similar to that indicated for this project, with sufficient production capacity to produce required units without causing delay in the work.

Installer Qualifications: Arrange for installation of metal fabrications specified in this section by same firm that fabricated them.

Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel," D1.3 "Structural Welding Code - Sheet Steel", and D1.2 "Structural Welding Code - Aluminum."

Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

PROJECT CONDITIONS

Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit, by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of Work.

Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabrication of products without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

PART 2 - PRODUCTS:

FERROUS METALS:

Metal Surfaces, General: For metal fabrications exposed to view upon completion of the Work, provide materials selected for their surface flatness, smoothness, and freedom form surface blemishes. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheet.

A. Structural-Steel Shapes: ASTM A 572 or ASTM A 992 (Fy=50 ksi)
B. Structural steel pipe: ASTM A53, standard weight (Schedule 40), black finish.
C. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500, GR B.
D. Plates, bars and angles: ASTM A36.
E. Anchor Rods, Bolts, Nuts: ASTM A 36.
F. Bolts, Nuts, and Washers: ASTM A 325, Type 1, high-strength heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers, uncoated.
G. Primer: Lead- and chromate-free, nonasphaltic, rust-inhibiting primer.

For exterior installations and where indicated, provide fabrications with hot-dip galvanized coating.

Uncoated Structural Steel Sheet: Product type (manufacturing method), quality, and grade, as follows:

A. Cold-Rolled Structural Steel Sheet: ASTM A 611, grade as follows:
B. Grade A, unless otherwise indicated or required by design loading.
C. Hot-Rolled Structural Steel Sheet: ASTM A 570, grade as follows:
D. Grade 30, unless otherwise indicated or required by design loading.

Uncoated Steel Sheet: Commercial quality, product type (method of manufacture) as follows:

A. Cold - Rolled Steel Sheet: ASTM A 366.
B. Hot - Rolled Steel Sheet: ASTM A 569

Galvanized Steel Sheet: Quality as follows:

A. Structural Quality: ASTM A 446; Grade A, unless another grade required for design loading, and G90 coating designation unless otherwise indicated.
B. Commercial Quality: ASTM A 526, G90 coating designation unless otherwise

indicated.

C. Type S, Grade A standard weight (schedule 40), unless otherwise indicated, or another grade or weight or both required by structural loads.

Provide Hot Dipped Galvanized finish for exterior installations and where indicated.

Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A 27. Provide bolts, washers, and shims as required, hot-dip galvanized per ASTM A 153.

Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for the metal alloy to be welded.

GROUT AND ANCHORING CEMENT

Non-shrink Nonmetallic Grout: ASTM C 1107; recommended by manufacturer for exterior applications.

Available Products: Subject to compliance with requirements, products that may be incorporated in the work include but are not limited to the following:

Products: Subject to compliance with requirements, provide one of the following:

Non-shrink Nonmetallic Grouts:

"Basal Construction Grout"; W. R. Bonsal Co.
"Euco N-S Grout"; Euclid Chemical Co.
"Kemset"; Chem-Masters Corp.
"Masterflow 713"; Master Builders.
"Sealtight 588 Grout"; W. R. Meadows, Inc.
"Sonogrout"; Sonneborn Building Products Div., Rexnord Chemical Products, Inc.
"Five Star Grout"; U. S. Grout Corp.
"Vibropruf #11"; Lambert Corp.

Fasteners:

General: Provide zinc coated fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade and class required.

A. Bolts and Nuts: Regular Hexagon head type, ASTM A 307, Grade A.
B. Lag Bolts: Square head type, FS FF-B-561.
C. Machine Screws: Cadmium plated steel, FS FF-S-92.
D. Wood Screws: Flat head carbon steel, FS FF-W-92.
E. Plain Washers: Round, carbon steel, FS FF-W-92.
F. Drilled- In Expansion Anchors: Expansion anchors complying with FS FF-S-325, Group VIII (anchors, expansion, (non-drilling), Type I(internally threaded tubular expansion anchor); and machine bolts complying with FS FF-B-575, Grade 5.
G. Toggle Bolts: Tumble-wing type, FS FF-B-588, type, class, and style as required.
H. Lock Washers: Helical spring type carbon steel, FS FF-W-84.

Paint:

Shop Primer for Ferrous Metal: Manufacturer's or fabricator's standard, fast-curing, lead-free, universal modified alkyd primer selected for good resistance to normal atmospheric corrosion, for compatibility with finish paint systems indicated, and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure complying with performance requirements of FS TT-P-645.

Galvanizing Repair Paint: High zinc dust content paint for re-galvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD - P- 21035 or SSPC-Paint-20.

Bituminous Paint: Cold-applied asphalt mastic complying SSPC-Paint 12 except containing no asbestos fibers.

Zinc Chromate Primer: FS TT-P-645.

Fabrication:

Fabrication shop shall have a minimum of three years experience in the field of steel fabrication. Steel erector shall have same minimum experience.

Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.

Temperature Change (Range): 100 deg F (55.5 deg C).

General: Shear and punch metals cleanly and accurately. Remove burrs and ease exposed edges. Form bent-metal corners to smallest radius possible without impairing work.

Submit shop drawings of all structural steel members. Shop drawings shall include fabrication piece drawings and field erection drawings. Structural construction drawings shall not be photocopied and submitted. Contractor to provide electronic copies for engineering review.

Welding: Weld corners and seams continuously. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. At exposed connections, finish welds and surfaces smooth with contour of welded surface matching those adjacent. Fabrication shop shall provide AWS welder certifications as requested by owner’s engineer.

Fabricate loose lintels from steel angles. Loose lintel angles shall be hot dipped galvanized unless noted other wise.

Fabricate steel pipe columns with steel top plates drilled for connection bolts and welded to pipe with continuous fillet weld same size as pipe wall thickness.

1. Provide base plates as scheduled on construction documents.

Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least

conspicuous.

Provide for anchorage of type indicated, coordinated with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.

Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. 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.

Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware and similar items.

Fabricate joints which will be exposed to weather in a manner to exclude water or provide weep holes where water may accumulate.

ERECTION

Perform cutting, drilling, and fitting required for installing miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack.

Fit exposed connections accurately together to form hairline joints.

All bolted moment conection shall have high strength bolts using “Turn-of-Nut” method according to RCSC’s specification structural joints using ASTM A325 or A490 Bolts and AISC “Manual of Steel Construction”.

A qualified independent inspector shall be hired by the contractor to provide inspection of all bolted and welded connections.

Loose Steel Lintels

Fabricate loose structural steel lintels form steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Use hot-dipped galvanized angles at exterior.

Design loose lintels for equal bearing of one inch per foot of clear span. Minimum bearing shall be not less than 8 inches bearing at each side of openings, unless otherwise indicated.

Hot-dipped galvanized loose steel lintels are required at all exterior wall openings.

Trench Frame with Solid Cover:
NEENAH Foundry Company; R-4990-CX (12”x 1-1/2” x 8) with Type D solid checkered top

Toilet Partition / Urinal Frames:
Fabricate steel tube frame using 1-1/2" and 2-1/2" x 3/16" vertical and horizontal numbers with 1/4" x 3/16" plates as shown on drawings. hot dipped galvanized, and painted. Shop drawings must be submitted to Architects office prior to fabrication. Provide Hardware as required for erection.

Knox Box: Provide Knox Box Model 3255 with Model 3240 Backbox at each access point to be located by Fire Department.

END OF SECTION 05500

SECTION 055100 – METAL STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Shop fabricated steel stairs with concrete pan treads and landings.
   2. Guard rails and handrails.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. American Welding Society (AWS)D1.1/D1.1M - Structural Welding Code - Steel.

B. ASTM International (ASTM):
   1. A36/A36M - Standard Specification for Carbon Structural Steel.
   2. A283 - Standard Specification for Low and Intermediate Strength Carbon Steel Plates.
   3. A307 - Standard Specification for Carbon Steel Externally Threaded Standard Fasteners.
   4. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   5. A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
   6. A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High- Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
   7. C94 - Standard Specification for Ready-Mixed Concrete.
   8. E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.

C. National Association of Architectural Metal Manufacturers (NAAMM) AMP 510 - Metal Stairs Manual.

D. Society for Protective Coatings (SSPC) - Painting Manual.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Design stair assembly to support a uniform live load of 100 PSF and a concentrated load of 300 pounds, with maximum deflection of L/240.
   2. Design guard rails and handrails to resist following without damage or permanent set:
      a. 50 pounds per linear foot applied in any direction at top, transferred via attachments and supports to building structure.

b. Concentrated 200 pound load applied in any direction at any point along top, transferred via attachments and supports to building structure.
c. Maximum deflection under loading: L/120.

3. Concentrated and uniform loads do not need to be applied simultaneously.
4. Perform design under direct supervision of Professional Structural Engineer licensed in the State of Texas, with minimum 2 years experience in work of this Section.

B. Fabricate stair assembly to NAAMM AMP 510, Commercial Class.

C. Fabricate guard rails and handrails in accordance with ASTM E985.

1.4 SUBMITTALS

A. Submittals for Review:
1. Shop Drawings:
a. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
b. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.

B. Quality Control Submittals:
1. Certificate of Compliance from Professional Structural Engineer performing system design.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Minimum 2 years experience in work of this Section.

B. Perform Work in accordance with ASTM E985.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store steel above ground on platforms, skids, or other supports; separate with wooden separators.

B. Protect steel from corrosion.

C. Prevent damage to prime coat.

PART 2 - PRODUCTS

2.1 MATERIALS – STEEL

A. Sections: ASTM A36/A36M

B. Plate: ASTM A283.

C. Pipe: ASTM A501.

D. Tube: ASTM A500.

E. Sheet: ASTM A1008/A1008M.

2.2 MATERIALS – CONCRETE

A. Concrete: ASTM C94; 3000 psi 28 day strength, 2 to 3 inch slump.

B. Concrete Reinforcement: Mesh type, unfinished

2.3 ACCESSORIES

A. Wire Mesh: Steel, 4 inch square openings, 0.25 inch wire diameter.

B. Bolts, Nuts, and Washers: ASTM A307.

C. Primer Paint: SSPC 15, Type 1, red oxide.

2.4 FABRICATION

A. Fit and shop assemble components in largest practical sections, for delivery to site.

B. Fabricate components with joints tightly fitted and secured.

C. Continuously weld connections. Welding to conform to AWS D1.1/D1.1M.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

F. Accurately form components required for anchorage of stairs, landings, and railings to each other and to building structure.

G. Treads and Landings:
   1. Fabricate from minimum 12 gage steel sheet, shaped to receive concrete.
   2. Fabricate stairs with closed steel sheet risers.
   3. Reinforce underside with steel angles when required to resist design loads.
   4. Secure pans to stringers with clip angles, welded in place.

H. Guard Rails and Handrails:
   1. Fabricate from steel pipe or tube stock.
   2. Provide vertical pickets between top and bottom rails spaced no more than 4” apart.
   3. Make bends uniform and free from buckles and other defects.

4. Where length exceeds that suitable for shipping and handling, fabricate in sections with concealed internal sleeves forming slip joints. Extend sleeves minimum 2 inches on both sides of joint; field weld and grind smooth.

2.5 FINISHES

A. Steel:
   1. Surface preparation: SSPC SP2 - Hand Tool Cleaning or SP3 - Power Tool Cleaning.
   2. Application: One coat; follow coating manufacturer's instructions.
   3. Minimum dry film thickness: 2.0 mils.
   4. Do not prime surfaces in direct contact with concrete or where field welding is required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion and defects.

B. Provide anchors, angles, hangers, and struts required for connecting stairs to structure.

C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

D. Field weld components indicated on Shop Drawings. Perform field welding in accordance with AWS D1.1/D1.1M.

E. Field bolt and weld to match shop bolting and welding. Conceal bolts and screws whenever possible.

F. Mechanically fasten joints butted tight, flush, and hairline. Grind welds smooth and flush.

G. Fill treads and landings with concrete. Consolidate concrete, strike off flush with perimeter frame, and apply light broom finish with striations parallel to long dimension of tread.

H. Installation Tolerances:
   1. Maximum variation from plumb: 1/4 inch per story, noncumulative.
   2. Maximum offset from true alignment: 1/4 inch.

3.2 ADJUSTING

A. Clean and touch up primer paint at welded and abraded surfaces with same product as applied in shop.

END OF SECTION 055100

SECTION 05511 FIXED ALUMINUM ACCESS LADDERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Fixed, wall mounted, vertical, aluminum and heavy duty, hatch access ladders.

B. Related sections:

1. Section 06100 - Rough Carpentry: Blocking in metal stud walls and partitions for anchorage of access ladders.

2. Section 07725 - Roof Hatch: Manufactured roof hatch to be accessed by aluminum ladder.

1.2 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI A14.3 - Ladders, Fixed, Safety Requirements.

B. American Society for Testing and Materials (ASTM) Publications:

1. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

2. ASTM B221 - Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.

1.3 SUBMITTALS

A. Provide in accordance with Section 01330 - Submittal Procedures:

1. Product data for access ladders and accessories.

2. Shop drawings showing elevations, dimensions, connections, and fabrication details.

3. Installation and maintenance instructions.

1.4 QUALITY ASSURANCE

A. Access ladders shall be designed and installed to comply with ANSI A14.3. and OSHA 1910.27

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. UPNOVR, Inc., 3Crane Way, New Hampshire 03106; 603-625-8639.

B. O'Keeffe's, Inc., 325 Newhall Street, San Fransisco, CA 94124; 888.653.3333

C. Manufacturers of equivalent products submitted and approved in accordance with Section 01630 - Product Substitution Procedures.

2.2 MATERIALS

A. Extruded aluminum: ASTM B221, Alloy 6063 Temper T-6, non-spark.

B. Sheet aluminum: ASTM B209 6063 Temper T-6.

C. Finish: Mill finished aluminum.

2.3 GENERAL FABRICATION

A. Field verify ladder dimensions prior to fabrication.

B. Fabricate to designs indicated on Drawings and to meet performance requirements specified in Paragraph 1.4.

C. Components shall be welded. Ladder shall not require field assembly.

2.4 VERTICAL FIXED ACCESS LADDER

A. Type: Fixed, wall mounted, vertical, aluminum, heavy duty, hatch access;

Model No. U-200 as manufactured by UPNOVR, Inc. / O'Keeffe Model 501.
B. Nominal height: As indicated on Drawings.
C. Side rails: 1-3/4 inches by 3 inches tubes with 1/8 inch wall thickness.
D. Rungs: 1-1/4 wide by 1-1/4 inches tube by [18] [24] inches long with corrugated surfaces and capable of 1,000 pounds load. Space 12 inches on center. Attach rungs in centerline of side rails by welding.

2.5 ACCESSORIES

A. Support brackets:

1. Wall brackets: Support ladder at top and bottom and at 48 inches maximum intermediate points with 2 by 1/4 inch minimum flat bar aluminum wall brackets. Allow 7 inches minimum clearance from wall to center line of rungs.
2. Floor brackets: Anchor side rails to floor with 2 by 1/4 inch minimum flat bar aluminum floor brackets. Allow 7 inches minimum clearance from wall to center line of rungs.

B. Security door: Provide hinged security door to cover bottom rungs and prevent unauthorized roof access.

1. Construction: Fabricate from 11 gage flat aluminum sheet covering front of ladder. Provide side flanges extending toward wall and meeting aluminum flange mounted to wall.
2. Equip door with continuous aluminum hinge and lock.

C. Safety post extension: Post extension for fixed ladders constructed of tubular aluminum sections with adjustable mounting brackets for attachment to top of ladder.

1. Operation: Upward and downward movement controlled by manual operation. Manually locks when fully extended.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to fabrication, field verify required dimensions.
B. Coordinate provision of access ladder with provision of roof hatch specified in Section 07725 - Roof Hatch to ensure height and position of ladder is compatible with roof hatch curb.
C. Coordinate ladder installation with construction of metal stud walls specified in Section 05400 - Cold Formed Metal Framing to ensure adequate support and blocking to ensure adequate support and blocking] for attachment of brackets and support of ladder.
D. Insulate dissimilar metals to prevent electrolysis with bituminous paint or non-absorptive isolation pad to prevent contact.

3.2 INSTALLATION

A. Install ladder in accordance with reviewed shop drawings.
B. Position ladder such that side rails [end 3 inches above] [contact] floor and center of rungs are 7 inches from wall.
C. Securely anchor support brackets with fasteners of type and size recommended by manufacturer. Place wall brackets at top and bottom of ladder and place floor brackets at bottom of ladder. Place intermediate wall brackets at 48 inches maximum.
D. Ensure ladder is vertical, plumb, aligned with center of roof hatch, and rigid.
E. Install security door assembly and adjust for smooth operation.
F. Safety post extension: Attach to top 2 rungs of ladder and centered between

side rails. Adjust post to extend 42 inches above top rung when roof hatch is open and post is fully extended.

G. After installation inspect ladder to verify proper, secure, and safe installation.

H. Clean ladder using clean water and mild detergent. Do not use abrasive agent, steel wool, or harsh chemicals. Rinse with clean water.

END OF SECTION

SECTION 05520 HANDRAILS AND RAILINGS

PART 1 GENERAL:

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Extent of handrails and railings is indicated on drawings and includes miscellaneous handrails and railings not included in other sections of these specifications.

Types of handrails and railings required include the following:

Steel Pipe railings.

SYSTEM PERFORMANCE

Structural Performances: Provide railing and handrail assemblies which, when installed, comply with the following minimum requirements for structural performance, unless otherwise indicated.

Handrails and Toprails: Capable of withstanding the following loads applied as indicated:

Concentrated load of 200 lbf applied at any point in any direction.

Uniform load of 50 lbf per linear ft. applied simultaneously in both vertical and horizontal directions.

Concentrated and uniform loads above need not be assumed to act concurrently.

Guards: Intermediate rails, balusters and panel fibers capable of withstanding a uniform lod of 25 lbf per sq. ft. of gross area of guard, including any open areas, of which they are a part.

Above load need not be assumed to be acting concurrently with uniform horizontal loads on toprails of railing assembly in determining stress on guard supporting members.

QUALITY ASSURANCE:

Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

SUBMITTALS:

Product Data: Submit manufacturer's product specifications and installation instruction for products and processes used in handrails and railings, including finishes and grout.

Shop Drawings: Submit shop drawings for fabrication and erection of handrails and

railings. Include plans, elevations and details of fittings, connections, and anchorages to other work. Provide templates for anchor and bolt installation by others.

Where materials or fabrications are indicated to comply with certain requirements for design loadings, include structural computations, material properties, and other information needed for structural analysis.

Samples: Submit samples for each type of metal finish indicated. Prepare samples on metal on same gage and alloy to be used in work. Where normal color and texture variations are to be expected, provide "range" samples showing limits of such variations.

PART 2 PRODUCTS

ACCEPTABLE MANUFACTURERS:

Steel Pipe Railing Manufacturers:

Julius Blum & Co., Inc.
J.G. Braun Co.
Craneveyor Corp.
KDI Paragon, Inc.
Reynolds Metal Co.
Tri Tech, Inc.
York Metal Fabricators, Inc.

MATERIALS:

Metals: Comply with standards indicated for forms and types of metals indicated or required for handrail and railing components.

Stainless Steel:

Tubing; ASTM A 554, Grades MT301, MT302, or MT 304, as standard with manufacturer.

Pipe: ASTM A 312. Grade TP 304, 1 1/2" Diameter Schedule 5..
Castings: ASTM A 743, Grade CF 8 or 20.

Plate: ASTM A 167, Type 301, 302, or 304.

Non Shrink Non Metallic Grout: Pre mixed, factory packaged, non staining, non corrosive,
non gaseous grout complying with CE CRD C621. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this section.

Welding Electrodes and Filler Metal: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded, and as required for color match, strength and compatibility in fabricated items.

Fasteners: Use fasteners of same basic metal as the fastened metal, unless otherwise indicated. Do not use metals which are corrosive or incompatible with materials joined.

Provide concealed fasteners for interconnection of handrail and railing components and for their attachment to other work, except where otherwise indicated.

Anchors and Inserts: Provide anchors of proper type, size, and material for type of loading and installation condition shown, as recommended by manufacturer, unless otherwise indicated. Use non ferrous metal of hot dipped galvanized anchors and inserts for exterior locations and elsewhere as required for corrosion resistance. Use toothed steel of lead expansion bolt devices for drilled in place anchors. Furnish inserts, as required, to be set in concrete or masonry work.

FABRICATION:

General: Fabricate handrails and railings to design, dimensions and details shown. Provide handrail and railing members in sizes and profiles indicated, with supporting posts and brackets of size and spacing shown, but not less than required to support the design loadings indicated.

Nonwelded Connections: Fabricate railings and handrails for interconnection of members
by means of railing manufacturer's standard concealed mechanical fasteners and fittings unless otherwise indicated. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

Fabricate splice joints for field connection using epoxy structural adhesive where this represents manufacturer's standard splicing method.

Brackets, Flanges, Fittings and Anchors: Provide manufacturer's standard wall brackets, flanges, miscellaneous fittings and anchors for interconnection of handrail and railing members to other work, unless otherwise indicated. Furnish inserts and other anchorage devices for connecting handrails and railings to concrete or masonry work.

Fabricate and space anchorage devices as indicated and as required to provide adequate support. Coordinate anchorage devices with supporting structure.

For railing posts set in concrete provide sleeves of galvanized steel, not less than 6" long and with inside dimensions not less than 1/2" greater than outside dimensions of post. Provide galvanized steel plate closure welded to bottom of sleeves, make closure 1" greater in length and width than outside dimensions of sleeve.

METAL FINISHES:

General: Comply with NAAMM "Metal Finishes Manual" for recommendations and designations of finishes, except as otherwise indicated.

All exterior railing to be Hot Dipped Galvanized.

PART 3 EXECUTION:

PREPARATION:

Coordinate setting drawings, diagrams, templates, instructions, and directions for

installation of anchorages, such as sleeves, concrete inserts, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete as masonry construction. Coordinate delivery of such items to project site.

Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress; allow for adjustments during installation where taking field measurements before fabrication might delay work.

INSTALLATION:

General:

Fit exposed connections accurately together to form tight, hairline joints.

Perform cutting, drilling and fitting required for installation of handrails and railings. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Do not weld, cut or abrade surfaces of handrails and railing components which have been coated or finished after fabrication, and are intended for field connection by mechanical means without further cutting or fitting.

Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal arc welding, for appearance and quality of welds made, and for methods used in correcting welding work. Weld connections which are not to be left as exposedjoints, but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch up shop paint coat.

Corrosion Protection: Coat concealed surfaces of aluminum, which will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

Adjust handrails and railings prior to anchoring to ensure matching alignment at abutting joints. Space posts at intervals indicated, or if not indicated, as required by design loadings.

Anchoring Posts:

Anchor posts in concrete by means of sleeves preset and anchored into concrete. After posts have been inserted into sleeves, fill annular space between posts and sleeve solid with non shrink, non metallic grout, mixed and placed to comply with grout manufacturer's directions.

Anchor posts in concrete by core drillings holes not less than 5" deep and 3/4" greater than outside dimensions of posts. Clean holes of all loose material, insert posts and fill annular space between post and concrete with non shrink, non metallic grout, mixed and placed to comply with grout manufacturer's directions.

Leave anchorage joint exposed; wipe off excess grout and leave 1/8" build up, sloped away from post. For installation exposed on exterior or to flow of water, seal grout to comply with grout manufacturer's directions.

Anchor posts to metal surfaces with manufacturer's standard fittings designed for this

purpose, unless otherwise indicated.

Provide removable railing sections as indicated, using slip fit metal sockets. Accurately locate sockets to match post spacing.

Railing Connections:

Permanently connect railing components together using manufacturer's standard mechanical or adhesive joinery method and fittings, unless otherwise indicated. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic filler cement colored to match finish of handrails and railings.

Permanently connect railing components by welding, using manufacturer's standard fitting designed for this purpose, unless otherwise indicated.

Anchoring Railing Ends:

Anchor railing ends into concrete or masonry with manufacturer's standard fittings designed for this purpose, unless otherwise indicated.

Anchor railing ends to metal surfaces with manufacturer's standard fittings using concealed fasteners, unless otherwise indicated.

Attachment of Handrails to Walls:

General: Secure handrails to walls with manufacturer's standard wall brackets and end fittings, unless otherwise indicated.

For concrete and solid masonry, use drilled in expansion shields and concealed hanger bolts, unless otherwise indicated.

For hollow masonry anchorage, use toggle bolts with square heads, unless otherwise indicated.

ADJUST AND CLEAN:

Protect finishes of railings and handrails from damage during construction period by use of temporary protective coverings approved by railing manufacturer. Remove protective covering at project completion or when directed by Architect. Restore finishes damaged during installation and construction period so that no evidence remains of correction work. Return items which cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units as required.

END OF SECTION 05520

SECTION 06100 - ROUGH CARPENTRY

PART 1 - GENERAL

RELATED DOCUMENTS:
Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:
Definition: Rough carpentry includes carpentry work not specified as part of other sections and which is generally not exposed, except as otherwise indicated. Types of work in this section include rough carpentry for:

Finish carpentry is specified in another section within Division 6.

REFERENCES:
Lumber Standards: Comply with PS 20 70 and with applicable rules of the respective grading and inspecting agencies for species and products indicated.

Plywood Product Standards: Comply with PS 1 (ANSI A 199.1) or, for products not manufactured under PS 1 provision, with applicable APA Performance Standard for type of panel indicated.

SUBMITTALS:
Wood Treatment Data: Submit treatment manufacturer's instructions for proper use of each type of treated material.

Preservative Treatment: For each type specified, include certification by treating plant stating type of preservative retained and conformance with applicable standards.

For water borne treatment, include statement that moisture content of treated materials was reduced to a maximum of 15% prior to shipment to project site.

PRODUCT HANDLING:
Delivery and Storage: Keep materials dry at all times. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels; provide for air circulation within stacks.

JOB CONDITIONS:
Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow attachment of other work.

PART 2 PRODUCTS

LUMBER, GENERAL:
Factory mark each piece of lumber with type, grade, mill and grading agency, except omit marking from surfaces to be exposed with transparent finish or without finish.

Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.

Provide dressed lumber, S4S, unless otherwise indicated.

Provide seasoned lumber with 19% maximum moisture content at time of dressing.

Framing Lumber (2" through 4" thick) (Wd Frm):

For light framing (less than 6" wide), provide "Stud" grade lumber for stud framing and "Standard" grade for other light framing, any species.

For light framing (less than 6" wide), provide the following grade, any species:

For structural framing (6" and wider and from 2" to 4" thick), provide the following grade and species:

Select Structural grade.
No. 1 grade.
No. 2 grade.
No. 3 grade.

Any species of the specified grade.
Any species and grade which meets or exceeds the following values:

Fb (minimum extreme fiber stress in bending); 1500 psi.
E (minimum modulus of elasticity); 1,500,000 psi.

Exposed Framing Lumber (2" through 4" thick):

Where framing will not be concealed by other work, provide the following grade and species:

Douglas Fir, Appearance Framing (WCLB or WWPA).
Southern Pine, Appearance Grade, Kiln Dried (SPIB).
Redwood Clear All Heart (RIS).
Boards (less than 2" thick).

Exposed Boards: Where boards will be exposed in the finished work, provide the following:

Moisture Content: 19% maximum, "S DRY."
Where painted finish is indicated, provide Southern Pine, No. 2 Boards per SPIB, or Douglas Fir Construction Boards (WCLB or WWPA).

Concealed Boards: Where boards will be concealed by other work, provide lumber of 19% maximum moisture content (S DRY) and of following species and grade:

Board Sizes: Provide sizes indicated or, if not indicated (for sheathing, sub flooring and similar uses), provide 1" x 8" boards.

MISCELLANEOUS, LUMBER:
Provide wood for support or attachment of other work including cant strips, bucks, nailers, blocking, furring, grounds, stripping and similar members. Provide lumber of sizes indicated, worked into shapes shown, and as follows:

Moisture content: 15% maximum for lumber items not specified to receive wood preservative treatment.

Grade: Construction Grade light framing size lumber of any species or board size lumber as required. Provide construction grade boards (RIS or WCLB) or No. 2 boards (SPIB or

WWPA).

PLYWOOD (Pwd):
Trademark: Identify each plywood panel with appropriate APA trademark.

Plywood Decking / Sheathing: Refer to Structural.

Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant treated plywood panels with grade designation, APA C-D PLUGGED INT with exterior glue, in thickness indicated, or, if not otherwise indicated, not less than ½".

Plywood Exterior Sheathing: Provide fire-retardant treated plywood panels with grade designation, APA C-D plugged exterior with exterior glue in thickness shown.

MISCELLANEOUS MATERIALS:
Fasteners and Anchorages: Provide size, type, material and finish as indicated and as recommended by applicable standards, complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices.

Provide metal hangers and framing anchors of the size and type recommended by the manufacturer for each use including recommended nails.

Where rough carpentry work is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners and anchorages with a hot dip zinc coating (ASTM A 153).

WOOD TREATMENT:
Preservative Treatment: Where lumber or plywood is indicated as "Trt Wd" or "Treated," or is specified herein to be treated, comply with applicable requirements of AWPA Standards C2 (Lumber) and C9 (Plywood) and of AWPB Standards listed below. Mark each treated item with the AWPB Quality Mark Requirements.

Pressure treat above ground items with water borne preservatives complying with AWPB LP 2. After treatment, kiln dry to maximum moisture content, respectively of 19% and 15%. Treat indicated items and the following:
Wood cants, nailers, curbs, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers and waterproofing.

Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces with heavy brush coat of same chemical used for treatment. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

Inspect each piece of treated lumber or plywood after drying and discard damaged of defective pieces.

BARRIER MEMBRANE AND FLASHING:
Membrane over Plywood (exterior): Acceptable Product: Sharkskin Ultra SA™ as manufactured by: Kirsch Building Products LLC, 1464 Madera Road, Suite 387, Simi Valley, CA 93065; Tel: (805) 750-0084 Fax: 805-526-1116; www.sharkskin.us.

Provide a self-adhered roof underlayment that has passed the requirements set forth in ICC/ES Report 1708 and Miami/Dade TAS 103.

PART 3 – EXECUTION

INSTALLATION, GENERAL:
Discard units of material with defects which might impair quality of work, and units which are too small to use in fabricating work with minimum joints or optimum joint arrangement.

Set carpentry work to required levels and lines, with members plumb and true to line and cut and fitted.

Securely attach carpentry work to substrate by anchoring and fastening as shown and as required by recognized standards.

Countersink fasteners on exposed carpentry work and fill holes.

Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; pre-drill as required.

WOOD GROUNDS, NAILERS, BLOCKING AND SLEEPERS:
Provide wherever shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.

Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

Provide permanent grounds of dressed, preservative treated, key beveled lumber not less than 1 1/2" wide and of thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required.

Fire stop concealed spaces with wood blocking not less than 2" thick, if not blocked by other framing members. Provide blocking at each building story level and at ends of joist spans.

Installation of Plywood:

General: Comply with applicable recommendations contained in Form No. E 304, "APA Design/Construction Guide Residential & Commercial," for types of plywood products and applications indicated.

Fastening Methods: Fasten panels as indicated below:
Sheathing: Screw to framing.
Plywood Backing Panels: Screw to supports.

Provide 5/8” plywood blocking panels at all exterior signage locations.

END OF SECTION 06100

SECTION 06200 - FINISH CARPENTRY

PART 1 - GENERAL

RELATED DOCUMENTS:
Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:
Definition: Finish carpentry includes carpentry work which is exposed to view, is non - structural, and which is not specified as part of other sections.

Types of finish carpentry work in this section include:

- Fascias
- Trim
- Wall Mounted Plastic Laminate

Rough carpentry is specified in another Division 6 section.

Builders Hardware and wood doors are specified in Division 8 sections.

Architectural woodwork is specified in another Division 6 section.

QUALITY ASSURANCE:
Factory mark each piece of lumber and plywood with type, grade, mill and grading agency identification; except omit marking from surfaces to receive transparent finish, and submit mill certificate that material has been inspected and graded in accordance with requirements if it cannot be marked on a concealed surface.

SUBMITTALS:
Product Data: Submit manufacturer's specifications and installation instructions for each item of factory fabricated siding and paneling.

PRODUCT DELIVERY, STORAGE AND HANDLING:
Protect finish carpentry materials during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

Do not deliver finish carpentry materials, until painting, wet work, grinding and similar operations which could damage, soil or deteriorate woodwork have been completed in installation areas. If, due to unforeseen circumstances, finish carpentry materials must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.

JOB CONDITIONS:
Conditioning: Installer shall advise Contractor of temperature and humidity requirements for finish carpentry installation areas. Do not install finish carpentry until required temperature and relative humidity have been stabilized and will be maintained in installation areas.

PART 2 - PRODUCTS

WOOD PRODUCT QUALITY STANDARDS:
Softwood Lumber Standards: Comply with PS 20 and with applicable grading rules of the respective grading and inspecting agency for the species and product indicated.

Plywood Standard: Comply with PS 1/ANSI A199.1.

Hardwood Lumber Standard: Comply with National Hardwood Lumber Association (NHLA) rules.

Hardwood Plywood Standard: Comply with PS 51.

Woodworking Standard: Where indicated for specific products comply with specified provision of the following:

Architectural Woodwork Institute (AWI) "Quality Standards."

Glued -up Lumber Standard: Comply with PS 56.

MATERIALS:
General:
Nominal sizes are indicated, except as shown by detailed dimensions. Provide dressed or worked and dressed lumber, as applicable, manufactured to the actual sizes as required by PS 20 or to actual sizes and pattern as shown, unless otherwise indicated.

Moisture Content of Softwood Lumber: Provide kiln -dried (KD) lumber having moisture content from time of manufacture until time of installation not greater than 6% to 11%.

Moisture Content of Hardwood Lumber: Provide kiln -dried (KD) lumber having moisture content from time of manufacture until time of installation from 6% to 11%.

Lumber for Transparent Finish (Stained or Clear): Use good grade pieces made of Cedar.
Lumber for Painted Finish: Any closed grain hardwood, AWI Section 300, custom grade.

INTERIOR FINISH CARPENTRY:
Shelving: 1" shelves 36" wide or over #1 SYP and ¾” for shelves under 36".

Cleats: #1 SYP.

Plastic Laminate: Countertops and backsplashes as per drawings.

Standards: Meet requirements and recommendations of applicable portions of standards listed.

Federal Specifications: FS equal to Wilson Art

Examining:

Examine surfaces that are to receive Laminated Plastic. Report unsatisfactory laminate condition.

Do not star installation of Laminated Plastic until satisfactory conditions have been corrected.

Proceeding with installation of Laminated Plastic will be constructed as evidence of acceptance of conditions under which work will be done.

Protecting:
Handle Laminated Plastic and items to avoid injury to person and to avoid damage to materials or to work in place. Satisfactorily repair or remove and replace work that has been damaged.

Protect adjacent surfaces from damage, soiling and adhering of adhesives and extra materials.

Protect Laminated Plastic from damage by weather and construction. Install necessary protective covering for surfaces that may have traffic during construction period.

Remove protective covering upon completion of project. Remove and replace work that has been damaged.

Delivering and Storing:

Deliver materials to site in manufacturer's original, unopened, labeled containers or packages.

Submit samples for approval of the Architect.

APPLICATION:
Trim shall be plumb and/or level with miter joints and finished as earlier specified. Pre-finished trim shall be required.

Application shall not take place sooner than 24 hours of temperatures less than 42 deg F.

Miscellaneous Materials:

Fasteners and Anchorages: Provide nails, screws and other anchoring devices of the type, size, materials and finish required for application indicated to provide secure attachment, concealed where possible, and complying with applicable Federal Specifications.

All interior and exterior nails shall be galvanized.

Where finish carpentry is exposed on exterior or in areas of high relative humidity, provide fasteners and anchorages with a hot-dipped zinc coating (ASTM A 153).

PART 3 - EXECUTION

PREPARATION:
Condition wood materials to the average humidity condition in installation areas prior to installing.

Back prime lumber for painted finish exposed on the exterior or, where indicated, to

moisture and high relative humidity on the interior. Comply with requirements of section on painting within Division 9 for primers and their application.

INSTALLATION:
Discard units of material which are unsound, warped, bowed, twisted, improperly treated, not adequately seasoned or too small to fabricate work with minimum of joints or optimum jointing arrangements, or which are of defective manufacturer with respect to surfaces, sizes or patterns.

Install the work plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8" in 8' -0" for plumb and level countertops; and with 1/16" maximum offset in flush adjoining 1/8" maximum offsets in revealed adjoining surfaces.

Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.

Anchor finish carpentry work to anchorage devices or blocking built -in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where pre-finished matching fasteners heads are required, use fine finishing nail for exposed nailing, countersunk and filled flush with finished surface, and matching final finish where transparent is indicated.

MILLWORK AND TRIM:
Exterior and interior millwork and trim shall conform to design and details shown. Where practical, work shall be finished and assembled at the mill. All mill work and trim shall be furnished smooth and free from machine and tool marks that will show through the finish. All nail heads shall be set to receive putty.

Doors and other movable parts shall be accurately fitted with proper clearances and left in perfect working order. Passage doors shall have a minimum clearance of 1/8" at sides and top, and doors and hardware shall be fitted to template so that they may be interchanged from opening to opening. All refitting necessary due to swelling shrinking, assembly or installation shall be done by this Contractor, for a period of one year after completion and acceptance of the building.

When dressing or cutting has been done, these surfaces shall be refinished. The work shall be left clean and free from warp, twist, open joints or other defects.

Metal thresholds: Fit and set metal thresholds in mastic.

LOCATION OF FINISH HARDWARE:
Locate hardware for door and door frames as follows unless shown otherwise on the drawings:

Center door knobs 38" above floor. Offset screen door latches to clear door locksets.

Center door pulls 42" above floor and push plates 48" above floors.

INSTALLATION OF WINDOWS:
Install windows and operating sash closed and locked, and set plumb, true, and centered in openings; securely anchored in place, using approved manufacturers

anchors specifically designed for use in the openings detailed.

Check all windows for smooth operation and proper function and adjust as required, prior to acceptance by the Architect.

ADJUSTMENT, CLEANING, FINISHING AND PROTECTION:
Repair damaged and defective finish carpentry work wherever possible to eliminate defects functionally and visually; where not possible to repair properly, replace woodwork. Adjust joinery for uniform appearance.

Refer to Division 9 sections for final finishing of installed finish carpentry work.

Protection: Installer of finish carpentry work shall advise Contractor of final protection and maintained conditions necessary to ensure that work will be without damage or deterioration at time of acceptance.

END OF SECTION 06200

SECTION 06400 - ARCHITECTURAL WOODWORK

PART 1 - GENERAL

RELATED DOCUMENTS:
Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:
Extent of each type of architectural woodwork is indicated on drawings and in schedules.

Types of architectural woodwork include the following:

- Shelving
- Millwork
- Countertops
- Toilet Partitions

Finish carpentry is specified in another section of Division 6.

QUALITY ASSURANCE:
AWI Quality Marking: Mark each assembled unit of architectural woodwork with manufacturer's identification and grade mark evidencing compliance with indicated AWI quality grade. Locate grade mark on surfaces which will not be exposed after installation. For other items requiring field assembly, a certification of compliance may be substituted for marking of individual pieces.

Arrange for architectural woodwork with sequence matched wood veneers to be produced by a single firm.

REFERENCES:
AWI Quality Standard: Comply with applicable requirements of “Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute (AWI), excets otherwise indicated.

SUBMITTALS:
Product Data: Submit manufacturer's specifications and installation instructions for each item of factory fabricated woodwork.

Certification: Include certification that fire -retardant treated materials comply with governing regulations.

Quality Certification: Submit Manufacturer's (Fabricator's) certification, stating that fabricated work complies with quality grades and other requirements indicated.

Shop Drawings: Submit shop drawings showing location of each item, dimensioned plans and elevations, large scale details, attachment devices and other components. Submit shop drawings for the following:

- Framed openings and lights, including trim.
- Shelving

PRODUCT DELIVERY, STORAGE AND HANDLING:
Protect woodwork during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

Do not deliver woodwork, until painting, wet work, grinding and similar operations which could damage, soil or deteriorate woodwork have been completed in installation areas. If, due to unforeseen circumstances, woodwork must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.

JOB CONDITIONS:
Conditioning: Woodwork Manufacturer and Installer shall advise Contractor of temperature and humidity requirements for woodwork installation and storage areas. Do not install woodwork until required temperature and relative humidity have been stabilized and will be maintained in installation areas.

Maintain temperature and humidity in installation area as required to maintain moisture content of installed woodwork within a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period.

The fabricator of woodwork shall determine optimum moisture content and required temperature and humidity condition.

PART 2 PRODUCTS
General: Except as otherwise indicated, comply with following requirements for architectural woodwork not specifically indicated as prefabricated or pre-finished standard products.

Wood Moisture Content: Provide kiln dried (KD) lumber with an average content range of 6% to 11% for interior work. Maintain temperature and relative humidity during fabrication, storage and finishing operations so that moisture content values for woodwork at time of installation do not exceed the following:

Interior Wood Finish: 5% - 10% for mild regions (as defined by AWI).

Plywood: Closed grain hardwood plywood with exterior glue complying with requirements for specified woodwork grade.

Plastic Laminate: Comply with NEMA LD-3 for type, thickness, color, pattern and finish as indicated for each application, or if not indicated, as selected by Architect from manufacturer's standard products as well as the following;

Wilsonart -	All Available Colors, including Premium Colors
Formica -	All Available Colors, including Premium Colors
Nevamar-	All Available Colors, including Premium Colors

Quality Standards: For following types of architectural woodwork; comply with indicated standards as applicable:

Standing and Running Trim: AWI Section 300.
Casework and Countertops: AWI Section 400.
Shelving: AWI Section 600.
Miscellaneous Work: AWI Section 700.
Exterior Frames: AWI Section 900.

Design and Construction Features: Comply with details shown for profile and construction of architectural woodwork, and, where not otherwise shown, comply with applicable Quality Standards, with alternate details as Fabricator's option.

Pre -Cut Openings: Fabricate architectural woodwork with pre -cut openings, where possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing -in diagrams for proper size and shape. Smooth edges of cutoffs and, where located in countertops and similar exposures seal edges of cutouts with a water -resistant coating.

Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit.

Where sequence of measuring substrates before fabrication would delay the project, proceed with fabrication (without field measurements) and provide ample borders and edges to allow for subsequent scribing and trimming of woodwork for accurate fit.

INTERIOR ARCHITECTURAL WOODWORK:
Core: Plywood. Particle core panels will not be accepted.

Construction: Reveal overlay.

Exposed Surfaces: Provide high pressure laminate in grades indicated for the following types of surfaces:

Horizontal Surfaces: GP -50 (0.050" nominal thickness).
Post Formed Surfaces: PF -42 (0.042" nominal thickness).
Vertical Surfaces: GP -28 (0.028" nominal thickness).

Except as otherwise indicated, provide separate plastic laminate countertops (installed over closed grain plywood substrate) to comply with requirements for casework for plastic laminate finish. Provide with coved backsplash. Note at science lab countertops, provide epoxy resin tops, black in color.

Fabricate exposed edges of casework, including edges of doors and drawers when open, with matching plastic laminate, except as otherwise indicated.

Shelves: 1" thick, reversible, plastic laminate finish all sides and all edges.

General: These requirements do not apply to shelving which is either integral with or indicated as "casework"; comply with casework requirements for those units of shelving.

Grade: Custom.

FINISH FOR ARCHITECTURAL WOODWORK:
General: The priming and pre-finishing (if any) of architectural woodwork required to be performed at the shop or factory is specified as work of this section. Refer to Division 9 sections for final finishing of installed architectural woodwork.

At the Contractor's option, he may use plastic laminate interior finish in lieu of painted surfaces.

Preparations for Finish: Comply with AWI Quality Standards, Section 1500, for sanding, filling countersunk fasteners, back priming and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.

CABINET HARDWARE AND ACCESSORY MATERIALS:

General: Provide cabinet hardware and accessory materials associated with architectural woodwork, except for units which are specified as "door hardware" in other sections of these specifications.

Hardware Standards: Except as otherwise indicated, comply with ANSI A156.9 " American National Standard for Cabinet Hardware".

Quality Level: Type 2 (institutional), unless otherwise indicated.

Quality Certification: Where available, provide cabinet hardware bearing the BHMA certification label, affixed either to hardware or its packaging, showing compliance with BHMA.

Cabinet Hardware Standard 201.

Cabinet Hardware: Provide all cabinet hardware required for proper installation and operation, whether listed below or not.

Metal Shelf Standards and Brackets: Provide one of the following:

No. 87 Standards and No. 187 Brackets; Knape & Vogt Mfg. Co.
Finish: Nickel-plated.

Pivoted Hinges: model no. Snap on 300 Series Hinge by Grass America

Finish for Butts and Hinges: Stain nickel-plated.

Cabinet Door Pulls: Steel Wire Pulls 4” C/C, Satin Chrome Finish

Door Pull Finish: Satin Chrome

Magnetic Cabinet Catches: Provide one of the following:

Aluminum, satin finish, No.916, Knape & Vogt.
Aluminum, satin finish, No.46 ALD, Standley Hardware Div.

Drawer Slides: KV 4100 Low Profile - Knape & Vogt Mfg. Co.

Locks: Master Lock Five (5) pin tumbler at all drawers and doors. Typical

Cabinet Door Hardware: Provide hinges, catches and pulls of types indicated, to accommodate each door size and style.

Drawer Hardware: Provide slides and pulls of types indicated, to accommodate each drawer size and style.

Equip each drawer with side-mounted, full-extension, ball-bearing, nylon roller drawer slides with load capacity of 75 lbs. per pair.

Locks: provide standard pin-type or disc-type (5 pins or discs) tumbler locks, keyed alike in each room, at all base and wall cabinets unless noted otherwise.

Shelf Supports: Where shelving is indicated as "adjustable:, provide slotted-type standards and brackets of type needed to properly support shelves with uniform 40-lb per sq. ft. loading.

Closet Bars: Telescoping steel or brass tubing, with forged end brackets; size and wall thickness as required to support full continuous hanging of clothing.

Exposed Hardware Finish: Provide exposed hardware with BHMA Code 626 satin chromium plate finish (US26D). Where not available, provide either satin aluminum or satin stainless steel finish.

PART 3 - EXECUTION

PREPARATION:
Condition woodwork to average prevailing humidity conditions in installation areas prior to installing.

Prior to installation of architectural woodwork, examine shop fabricated work for completion, and complete work as required, including back priming and removal of packing.

INSTALLATION:
Install woodwork plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8" in 8' -0" for plumb and level (including countertops); and with 1/16" maximum offset in flush adjoining surfaces, 1/8" maximum offsets in revealed adjoining surfaces.

Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.

Standing and Running Trim: Install with minimum number of joints possible, using full length pieces (from maximum length of lumber available) to the greatest extent possible. Stagger joints in adjacent and related members. Cope at returns, miter at corners and comply with referenced Quality Standards for joinery.

Anchor woodwork to anchors or blocking built -in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where pre-finished matching fasteners heads are required, use fine finishing nails for exposing nailing, countersunk and filled flush with woodwork, and matching final finish where transparent finish is indicated.

Wood Storage Shelving: Complete the assembly of units and install in the areas indicated, including hardware and accessories as indicated.

ADJUSTMENT, CLEANING, FINISHING AND PROTECTION:
Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair replace woodwork. Adjust joinery for uniform appearance.

Clean woodwork on exposed and semi -exposed surfaces. Touch up shop applied finishes restoring damaged or soiled areas.

Protection: Installer of architectural woodwork shall advise Contractor of final protection and maintained conditions necessary to ensure that work will be without damage or deterioration at time of acceptance.

END OF SECTION 06400

SECTION 07115 - SHEET WATERPROOFING

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Extent of each type of sheet waterproofing work is indicated on drawings.

Types of sheet waterproofing specified in this section include the following;
Bathroom Sheet Waterproofing

QUALITY ASSURANCE:

Manufacturer: Obtain primary waterproofing materials of each type required from a single manufacturer, to greatest extent possible. Provide secondary materials only as recommended by manufacturer of primary materials.

Installer: Firm with not less than 3 years of successful experience in installation of waterproofing similar to requirements for this project and which is acceptable to manufacturer of primary waterproofing materials.

SUBMITTALS:

Product Data: Submit product data and general recommendations from waterproofing materials manufacturer, for types of waterproofing required. Include data substantiating that materials comply with requirements.

JOB CONDITIONS:

Substrate: Proceed with work after substrate construction, openings, and penetrating work have been completed.

Weather: Proceed with waterproofing and associated work only when existing and forecasted weather conditions will permit work to be performed in accordance with manufacturers' recommendations and warranty requirements.

PART 2 - PRODUCTS

MATERIALS:

General: Provide sheet waterproofing materials complying with required performance. Other similar materials certified in writing to be equal-or-better than specified may be used if acceptable to Architect.

WATERPROOFING:
Sheet Membrane Waterproofing as manufactured by Schluter® and carrying name brand permanently imprinted at regular intervals, shall be used for all concealed flashing and/or

membrane waterproofing, and installed in accordance with the manufactures directions and recommendations.

Available Products: Subject to compliance with requirements, provide one of the following:

Schluter®- equal to KERDI Shower System system
All other products must receive prior approval

MISCELLANEOUS MATERIALS:

Adhesives: Provide types of adhesive compound and tapes recommended by waterproofing sheet manufacturer, for bonding to substrate (if required), for waterproof sealing of seams in membrane, and for waterproof sealing of joints between membrane and flashings, adjoining surfaces and projections through membrane.

Primers: Provide type of concrete primer recommended by manufacturer of sheet waterproofing material for applications required.

PART 3 - EXECUTION

PREPARATION:

Prior to installation of waterproofing and associated work, meet at project site with Installer of each component of associated work, inspection and testing agency representatives (if any), and installers of work requiring coordination with waterproofing work. Review material selections and procedures to be followed in performing work.

INSTALLATION:

Comply with manufacturer's instructions for handling and installation of sheet waterproofing materials.

1. The substrate must be clean, even, and load bearing. The thin-set mortar used for bonding KERDI must be appropriate for the substrate, and it must penetrate and engage the KERDI fleece. Generally, an unmodified thin-set mortar is used. Cut KERDI to size prior to application.
2. Apply thin-set mortar to the substrate using a 1/4" x 3/16" (6 mm x 5 mm) V-notched trowel or the Schluter®-KERDI-TROWEL, which features a 1/8" x 1/8" (3 mm x 3 mm) square-notched design (Note the open time of the mortar). Press KERDI fully into the bond coat. Work the KERDI into the mortar by applying pressure to the membrane with the flat side of the trowel (held at an angle) in smooth, diagonal sweeps. Air bubbles must be removed.
3. Seams can be constructed by overlapping the edges of the KERDI by 2" (5 cm) using unmodified thin-set mortar, or by abutting the edges and covering the joint with Schluter®-KERDI-BAND using an unmodified thin-set mortar.
4. For inside and outside corners, adhere preformed Schluter®-KERDI-KERECK-F corners. For floor/wall connections, use KERDI-BAND. Install Schluter®-KERDI-SEAL-PS pipe seals at the showerhead, body sprays, etc. and Schluter®-KERDI-SEAL-MV at the mixing valve. As an alternative to KERDI-SEAL-PS/-MV, Schluter®-KERDI-FIX or other suitable sealant can be used to seal pipe protrusions and protect moisture-sensitive solid backing panels at the mixing valve.
5. Connections to fixed building elements can be achieved by using KERDI, KERDI-

BAND, or KERDI-FLEX in conjunction with KERDI-FIX, suitable trowel-applied waterproofing materials (such as urethane or similar), that require atmospheric moisture to cure, or other suitable sealing compounds.

6. KERDI shall be separated at existing expansion, structural, and flexible edge joints. Cover the joints with KERDI-FLEX. To allow for greater movement, the center section of the KERDI-FLEX can be tucked into the cavity of the expansion joint prior to bonding.
7. Once the entire membrane — with seams, corners, and connections — has been completely bonded, and therefore waterproofed, the covering may be applied.
8. Water testing of the assembly prior to setting tile, wait 24 hours to allow for final set of the mortar before testing to ensure waterproof performance of the assembly at seams and connections.
9. For tile installations using the thin-bed method, apply unmodified thin-set mortar directly to the exposed KERDI surface and install the tiles, ensuring full coverage. For acid-resistant coverings, use an epoxy adhesive to set and grout the tile.

Coordinate installation of waterproofing materials and associated work to provide complete system complying with combined recommendations of manufacturers and installers involved in work. Schedule installation to minimize period of exposure of sheet waterproofing materials.

Extend waterproofing sheet and flashings as shown to provide complete membrane over area indicated to be waterproofed. Seal to projections through membrane and seal seams. Bond to vertical surfaces and also, where shown or recommended by manufacturer, bond to horizontal surfaces.

At structural steel members, mechanically fasten waterproofing to top flange or steel members at 48 inches o.c. and a maximum of 24" vertically.

PERFORMANCE REQUIREMENTS:

PROTECTION:
Institute all required procedures for protection of completed membrane during installation of work over membrane and throughout remainder of construction period. Do not allow traffic of any type on unprotected membrane.

END OF SECTION 07115

SECTION 07200 - INSULATION

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Extent of insulation work is shown on drawings and indicated by provisions of this section.

Applications of insulation specified in this section include the following:

Blanket type building insulation

Board Type Building Insulation, concealed

QUALITY ASSURANCE:
Thermal Conductivity: Thicknesses indicated are for thermal conductivity (k value at 75 degrees F or 24 degrees C) specified for each material. Provide adjusted thicknesses as directed for equivalent use of material having a different thermal conductivity. Where insulation is identified by "R" value, provide thickness required to achieve indicated value.

Fire and Insurance Ratings: Comply with fire resistance, flammability and insurance ratings indicated, and comply with regulations as interpreted by governing authorities.

Federal Specifications: Where compliance with FS standard is indicated, specified requirements for marking individual boards/batts/blankets are waived, provided packages of units are labeled to show compliance.

SUBMITTALS:
Product Data: Submit manufacturer's product specifications and installation instructions for each type of insulation and vapor barrier material required.

PRODUCT HANDLING:
General Protection: Protect insulations from physical damage and from becoming wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage and protection during installation.

Protection for plastic insulation:

Do not expose to sunlight, except to extent necessary for period of installation and concealment.

Protect against ignition at all times. Do not deliver plastic insulating materials to project site ahead of installation time. Complete installation and concealment of plastic materials as rapidly as possible in each area of work.

PART 2 - PRODUCTS

MATERIALS:

Cavity Wall Insulation: Extruded Polystyrene Board Insulation (EPsBd Ins): Rigid, Closed cell, extruded polystyrene thermal board insulation with integral high density skin; complying with ASTM C 578-95, Type IV, min 25 psi compressive strength, k vale of 0.20; maximum water absorption 0.1% by volume; 1.1 perm inch max. water vapor transmission. Thickness: As Noted. Provide manufacturer's standard lengths and widths.

Available Manufacturers:

Dow Chemical Co.; Midland, MI
UC Industries/U.S. Gypsum; Chicago, IL

Mastic: 1. For Styrofoam SM: Styrofoam Brand No. 11.

Mineral/Glass Fiber Blanket/Batt Insulation (M/GFB Ins): Inorganic (non-asbestos) fibers formed with hinders into resilient flexible blankets or semi rigid batts; FS HH I 521, Type as indicate, densities of not less than 0.5 lb. per cu. ft. for glass fiber units and not less than 2.5 lb. per cu. ft. for mineral wool units, k value of 0.27; manufacturer's standard lengths and widths as required to coordinate with spaces to be insulated; types as follows:

Provide Type I - to be used in metal stud exterior partitions, “Thermal FSK-25 Faced Batts” EcoTouch Pink FIBERGLAS by Owens Corning or equal with the following characteristics:

Mildew and Fungi resistance, Maximum Flame Spread Index 25 or less, Smoke Developed index of 50.
Provide an R-value of 19, when 6" studs are used and an R-value of 13 when 3-5/8” studs are used.

Available Manufacturer's:
Certain Teed Products Corp.; Valley Forge, PA.
Clecon Inc.; Cleveland, OH.
Manville Bldg. Materials Corp.; Denver, Co.
Mizell Bros. Co.; Atlanta, GA.
Owens Corning Fiberglass Corp.; Toledo, OH.

Provide sound attenuation blankets at interior metal stud partitions. Refer to Section 07201 for more information.

PART 3 EXECUTION

INSPECTION AND PREPARATION:

Installer must examine substrates and conditions under which insulation work is to be performed, and must notify Contractor in writing of unsatisfactory conditions. Do not proceed with insulation work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

Clean substrates of substances harmful to insulations or vapor barriers, including removal of projections which might puncture vapor retarders.

INSTALLATION

GENERAL:
Comply with manufacturer's instructions for particular conditions of installation in each case. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with work.

Extend insulation full thickness as shown over entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections which interfere with placement.

Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.

CAVITY - WALL AND MASONRY-CELL INSULATION:
On units of plastic insulation, install small pads of adhesive spaced approximately 1'-0" o.c. both ways on inside face, as recommended by manufacturer. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside width of masonry or other construction as shown.
Wedge insulation from outside wythe of construction with small fragments of masonry materials spaced 2' -0" o.c. both ways.

GENERAL BUILDING INSULATION:

Apply insulation units to substrate by method indicated, complying with manufacturer's recommendations. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

Set vapor retarder faced units with vapor retarder to warm side of construction, except as otherwise indicated. Do not obstruct ventilation spaces, except for fire stopping.

Set reflective foil faced units accurately with air space in front of foil as shown. Provide not less than 0.75" air space where possible.

Lap edges of sheets of vapor barrier not less than 4" so as to provide complete coverage of protected areas.

PROTECTION:

General: Protect installed insulation and vapor retarders from harmful weather exposures and from possible physical abuses, where possible by non-delayed installation of concealing work or, where that is not possible, by temporary covering or enclosure. Installer shall advise Contractor of exposure hazards, including possible sources of deterioration and fire hazards.

CLEAN-UP:

Remove and dispose of excess insulation, wrappings and other waste materials.

END OF SECTION 07200

SECTION 07201 - SOUND ATTENUATION BLANKETS

PART 1 - GENERAL

SCOPE

A. Perform all work required completing the Sound Attenuation Blanket Installation as indicated by the Contract Documents and furnish all supplementary items necessary for their proper installation.

B. The requirements of Division 0 - "Bidding and Contract Requirements" and Division 1 - "General Requirements" of this Project Manual shall apply to all work required for this Section.

SUBMITTALS

A. Shop Drawings: Submit manufacturer's literature and mark sufficiently to indicate compliance with these specifications.

PART 2 - PRODUCTS

ACCEPTABLE PRODUCT/MATERIAL MANUFACTURERS

A. A specific product or material manufactured by any of the following listed manufacturers is "acceptable" (not "approved") only if the specific product or material can evidence exact compliance with the Contract Documents.

    1. Owens/Corning Fiberglass Corp.;
    2. Forty-eight Insulations, Inc.
    3. Manville
    4. Certain Teed Corporation
    5. United States Gypsum

B. Refer to Section 01630 - Substitutions and Product Options for manufacturers not listed above.

MATERIALS

A. INSULATION: Sound Attenuation Blanket, 3 5/8” thickness for 4” partition and 6 ½” thick for 6" partition, unless otherwise indicated. Rated noncombustible when tested per ASTM E136.

PART 3 - EXECUTION:

INSTALLATION

A. Install at metal stud wall locations indicated.
B. Install in exact accordance with manufacturer's latest published requirements, specifications and details, and as indicated.

PROTECTION AND CLEANING

A. Protect all finished surfaces from damage or staining. Remove and replace all damaged or stained products.

B. Remove excess materials and debris from site.

END OF SECTION 07201

SECTION 07210 - ROOF AND DECK INSULATION

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide all labor, equipment, and materials to install rigid insulation, tapered insulation and Securock over deck substrates indicated on the drawings. Install cants, crickets and saddles where indicated on drawings.

1.02 RELATED SECTIONS

A. Division 6 "Rough Carpentry"

B. Division 7 "Preparation for Re-roofing"

C. Division 7 “Modified Bituminous Sheet Roofing”

1.03 SUBMITTALS

A. Samples and product literature for all products listed.

B. Design Loads: Submit copy of minimum design load calculations according to ASCE 7-10, sealed by a Texas registered professional engineer. In no case shall the design loads be taken to be less than those detailed in article 1.06 of this specification.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original unopened packages, dry, undamaged, seals and labels intact.

B. Store all insulation delivered to the site in enclosed trailers.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Apply insulation only when the weather conditions are in compliance with the roof system limitations.

B. Protect the installed insulation from water penetration at the end of each day's work.

C. Application of the roof system shall immediately follow the installation of the roof insulation as it is installed.

1.06 DESIGN AND PERFORMANCE CRITERIA

A. Uniform Wind Uplift Load Capacity:
Submit documentation stating the assembly has been designed to meet a wind pressure defined by the Structural Engineer and IBC current edition.

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PART 2 - PRODUCTS

2.01 GENERAL

A. When a particular make or trade name is specified, it shall be indicative of a standard required.

2.02 MATERIALS

A. Polyisocyanurate Insulation Board: ASTM C 1289 Type II, Class 1. 3.3-inch. R-value= 25 above deck. Provide in 4 ft. by 8 ft. sizes. ACFoam-II, Atlas Roofing Corporation.

B. Tapered Polyisocyanurate Insulation Board Insulation Board: minimum 2-inch start, 1/2" per foot for sumps, crickets and saddles where indicated on the plans.

C. Recover Board: DensDek, 1/2-inch.

D. Parapet Sheathing: DensDeck Prime, 5/8”

2.03 RELATED MATERIALS

A. As indicated on plans.

B. Fasteners & Plates:
1. Steel Deck: CRHD fasteners with steel plates, Olympic Mfg.

C. Roof Board Joint Tape: Six (6) inches wide glass fiber mat with adhesive compatible with insulation board facers.

D. Cant Strips: Fiberglass, Glass Cant.
Wood Cants: Specified in Section 06100

E As required by the membrane manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrate surfaces to receive roof and deck insulation and associated work and conditions under which insulation will be installed. Do not proceed with roofing until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

B. Verify deck and surfaces are clean, smooth, dry, free of depressions or irregularities prior to beginning installation of materials.

C. Verify roof openings, curbs, pipes, sleeves, ducts, penetrations or vents through roof are solidly set, wood nailing strips are in place.

D. Verify all specifications related to Carpentry, have been followed prior to beginning installation of insulation. Beginning installation means acceptance of substrate.

3.02 PROTECTION

A. During execution of work covered by this Section, the Contractor shall provide protection for roof insulation from water and wind penetration at the end of each day's work.

B. Protect the roof insulation in areas that will receive excessive traffic with a surface protection such as plywood.

C. All workmen shall wear clean, soft rubber-soled shoes for any application work where they may be walking on the in-place insulation.

3.03 GENERAL INSTALLATION

A. Insulation board covered by Securock Prime shall be fully attached with specified fastening system as listed below.

Provide test reports showing fastening pattern to comply with Wind Design Pressures.

B. Filler pieces of insulation require at least two fasteners per piece if size of insulation is less than four square feet.

C. Offset joints of Securock with those of the Insulation. Minimum penetration into deck shall be as recommended by the fastener manufacturer. There is a one (1) inch minimum for metal.

D. All boards shall be cut and fitted where the roof deck intersects a vertical surface. The boards shall be cut to fit a minimum of 1/4" away from the vertical surface.

E. Sump all roof drains 3 feet square and sump insulation at all scuppers.

F. Cant Strips/Tapered Edge/Crickets: Install preformed 45-degree cant strips at junctures of vertical surface. Install crickets where indicated on the plans.

END OF SECTION

SECTION 07240 - EXTERIOR INSULATION AND FINISH SYSTEM CLASS PB

PART I – GENERAL

1.01 SUMMARY

A. This document is to be used in preparing specifications for projects utilizing the Dryvit Outsulation System. For complete product description and usage refer to:
   1. Dryvit Outsulation System Data Sheet, DS447
   2. Dryvit Outsulation System Application Instructions, DS204
   3. Dryvit Outsulation System Installation Details, DS107

B. Related Sections
   1. Unit Masonry – Section 04200
   2. Concrete – Sections 03010
   3. Cold Formed Metal Framing – Section 05400
   4. Wood Framing – Section 06100
   5. Joint Protection – Section 07900
   6. Flashing – Section 07600
   7. Air Barrier System– Section 07250

1.02. REFERENCES

A. Section Includes
   1. ASTM B 117 (Federal Test Standard 141A Method 6061) Standard Practice for Operating Salt Spray (Fog) Apparatus
   2. ASTM C 150 Standard Specification for Portland Cement
   3. ASTM C 297 Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions
   4. ASTM C 1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
   5. ASTM C 1396 (formerly C 79) Standard Specification for Gypsum Board
   6. ASTM D 968 (Federal Test Standard 141A Method 6191) Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
   7. ASTM D 2247 (Federal Test Standard 141A Method 6201) Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
   8. ASTM D 2898 Standard Test Method for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing
   9. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
   10. ASTM D 4060 Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
   11. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
   12. ASTM E 96 Standard Test Methods for Water Vapor Transmission of Materials
   13. ASTM E 119 Standard Method for Fire Tests of Building Construction and Materials
   14. ASTM E 330 Test Method for Structural Performance of Exterior Windows, Doors and Curtain Walls by Uniform Static Air Pressure Difference
   15. ASTM E 331 Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference.
   16. ASTM E 2098 Test Method for Determining the Tensile Breaking Strength of Glass Fiber Reinforcing Mesh for use in Class PB Exterior Insulation and Finish Systems (EIFS), after Exposure to Sodium Hydroxide Solution
   17. ASTM E 2134 Test Method for Evaluating the Tensile-Adhesion Performance of Exterior Insulation and Finish Systems (EIFS)
   18. ASTM E 2430 Standard Specification for Expanded Polystyrene (EPS) Thermal Insulation Boards for use in Exterior Insulation and Finish System (EIFS)

19. ASTM E 2485 (formerly EIMA Std. 101.01) Standard Test Method for Freeze-Thaw Resistance of Exterior Insulation and Finish Systems (EIFS) and Water-Resistive Barrier Coatings
20. ASTM E 2486 (formerly EIMA Std. 101.86) Standard Test Method for Impact Resistance of Class PB and PI Exterior Insulation and Finish Systems (EIFS)
21. ASTM E 2568 Standard Specification for PB Exterior Insulation and Finish Systems
22. ASTM G 155 (Federal Test Standard 141A Method 6151) Standard Practice for Operating-Xenon Arc Light Apparatus, for Exposure of Nonmetallic Materials
23. DS131, Dryvit Expanded Polystyrene Insulation Board Specification
24. DS135, Specification for Outsulation System with Mechanical Fasteners
25. DS151, Custom Brick™ Polymer System Specifications for Use on Vertical Walls
26. DS152, Dryvit Cleaning and Recoating
27. DS153, Dryvit Expansion Joints and Sealants
28. DS159, Dryvit Water Vapor Transmission
29. DS456, Rapidry DM™ 35-50 or DS457, Rapidry DM™ 50-75 Data Sheets
30. DS494, Dryvit AquaFlash® System
31. DS455, Backstop® NT™
32. DS705, Reflectit™
33. Mil Std E5272 Environmental Testing
34. Mil Std 810B Environmental Test Methods
35. UBC Std 26-4 (Formerly UBC 17-6) Multi-Story Fire Evaluation of Exterior Non Load-Bearing Foam Plastic Insulated Wall Systems
36. NFPA 268 Standard Test Method for Determining Ignitibility of Exterior Wall Assemblies Using a Radiant Heat Energy Source
37. NFPA 285 Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Non Load-Bearing Wall Assemblies Containing Combustible Components Using the Intermediate-Scale, Multistory Test Apparatus
38. ULC S101 Standard Methods of Fire Endurance Tests of Building Construction Materials
39. ANSI FM 4880 Evaluating Insulated Wall or Wall and Roof/Ceiling Assemblies; Plastic Interior Finish Materials; Plastic Exterior Building Panels; Wall/Ceiling Coating Systems; Interior or Exterior Finish Systems

1.03 DEFINITIONS

A. Base Coat: Material used to encapsulate one or more layers of reinforcing mesh fully embedded that is applied to the outside surface of the EPS.
B. Building Expansion Joint: A joint through the entire building structure designed to accommodate structural movement.
C. Contractor: The contractor that installs the Outsulation System to the substrate.
D. Dryvit: Dryvit Systems, Inc., the manufacturer of the Outsulation System, a Rhode Island corporation.
E. Expansion Joint: A structural discontinuity in the Outsulation System.
F. Finish: An acrylic-based coating, available in a variety of textures and colors that is applied over the base coat.
G. Insulation Board: Expanded polystyrene (EPS) insulation board, which is affixed to the substrate and creates a layer of continuous insulation.
H. Panel Erector: The contractor who installs the panelized Outsulation System.
I. Panel Fabricator: The contractor who fabricates the panelized Outsulation System.
J. Reinforcing Mesh: Glass fiber mesh(es) used to reinforce the base coat and to provide impact resistance.
K. Sheathing: A substrate in sheet form.
L. Substrate: The material to which the Outsulation System is affixed.
M. Substrate System: The total wall assembly including the attached substrate to which the Outsulation System is affixed.

1.04 SYSTEM DESCRIPTION

A. General: The Dryvit Outsulation System is an Exterior Insulation and Finish System, Class PB, consisting of an adhesive, expanded polystyrene insulation board, base coat, reinforcing mesh(es) and finish. Mechanically attached systems shall conform to Dryvit specification DS135.

B. Methods of Installation

1. Field Applied: The Outsulation System is applied to the substrate system in place.
2. Panelized: The Outsulation System is shop-applied to the prefabricated wall panels.

C. Design Requirements

1. Acceptable substrates for the Outsulation System shall be:
   a. Exterior grade gypsum sheathing meeting ASTM C 1396 (formerly C 79) requirements for water-resistant core or Type X core at the time of application of the Outsulation System.
   b. Exterior sheathing having a water-resistant core with fiberglass mat facers meeting ASTM C 1177.
   c. Exterior fiber reinforced cement or calcium silicate boards.
   d. APA Exterior or Exposure 1 Rated Plywood, Grade C-D or better, nominal 1/2 in (12.7 mm), minimum installed with the C face out.
2. Deflection of substrate systems shall not exceed 1/240 times the span.
3. The substrate shall be flat within 1/4 in (6.4 mm) in a 4 ft (1.2 m) radius.
4. The slope of inclined surfaces shall not be less than 6 in 12 (27°), and the length shall not exceed 12 in (305 mm).
5. All areas requiring an impact resistance classification higher than “standard”, as defined by ASTM E 2486 (formerly EIMA Std. 101.86), shall be as detailed in the drawings and described in the contract documents. Refer to Section 1.04.D.1.c of this specification.
6. Expansion Joints
   a. Design and location of expansion joints in the Outsulation System is the responsibility of the project designer and shall be noted on the project drawings. As a minimum, expansion joints shall be placed at the following locations:
      1) Where expansion joints occur in the substrate system
      2) Where building expansion joints occur
      3) At floor lines in wood frame construction
      4) At floor lines of non-wood framed buildings where significant movement is expected
      5) Where the Outsulation System abuts dissimilar materials
      6) Where the substrate type changes
      7) Where prefabricated panels abut one another
      8) In continuous elevations at intervals not exceeding 75 ft (23 m)
      9) Where significant structural movement occurs such as changes in roofline, building shape or structural system
7. Terminations
   a. Prior to applying the Dryvit Outsulation System, wall openings shall be treated with Dryvit AquaFlash System or Flashing Tape. Refer to Dryvit Outsulation System Installation Details, DS107.
   b. The Outsulation System shall be held back from adjoining materials around openings and penetrations such as windows, doors and mechanical equipment a minimum of 3/4 in (19 mm) for sealant application. See Dryvit's Outsulation System Installation Details, DS107.
   c. The system shall be terminated a minimum of 8 in (203 mm) above finished grade.
   d. Sealants
      1) Shall be manufactured and supplied by others.

2) Shall be compatible with Outsulation System materials. Refer to current Dryvit Publication DS153 for listing of sealants tested by sealant manufacturer for compatibility.
3) The sealant backer rod shall be of closed cell.

8. Vapor Retarders – The use and location of vapor retarders within a wall assembly is the responsibility of the project designer and shall comply with local building code requirements. The type and location shall be noted on the project drawings and specifications. Vapor retarders may be inappropriate in certain climates and can result in condensation within the wall assembly. Refer to Dryvit Publication DS159 for additional information.
9. Dark Colors - The use of dark colors must be considered in relation to wall surface temperature as a function of local climatic conditions. Use of dark colors in high temperature climates can affect the performance of the system.
10. Flashing: Shall be provided at all roof-wall intersections, windows, doors, chimneys, decks, balconies and other areas as necessary to prevent water from entering behind the Outsulation System.

D. Performance Requirements
1. The Outsulation System shall have been tested as follows:
a. Durability

TEST	TEST METHOD	CRITERIA	RESULTS
Abrasion Resistance	ASTM D 968	No deleterious effects after 528 quarts (500 liters)	No deleterious effects after 1056 quarts (1000 liters)
Accelerated Weathering	ASTM G 155 Cycle 1	No deleterious effects after 2000 hours	No deleterious effects after 5000 hours
	ASTM G 154 Cycle 1 (QUV)		No deleterious effects after 5000 hours
Freeze-Thaw	ASTM E 2485 Method A	No deleterious effects after 60 cycles	Passed - No deleterious effects after 90 cycles
	ASTM C 67 modified	No deleterious effects after 60 cycles	Passed - No deleterious effects after 60 cycles
	ASTM E 2485 Method A	No deleterious effects after 10 cycles	Passed - No deleterious effects after 10 cycles
Mildew Resistance	ASTM D 3273	No growth during 28 day exposure period	No growth during 60 day exposure period
Water Resistance	ASTM D 2247*	No deleterious effects after 14 days exposure	No deleterious effects after 42 days exposure
Taber Abrasion	ASTM D 4060	N/A	Passed 1000 cycles
Salt Spray Resistance	ASTM B 117*	No deleterious effects after 300 hours exposure	No deleterious effects after 1000 hours exposure
Water Penetration	ASTM E 331*	No water penetration beyond the inner-most plane of the wall after 2 hours at 6.24 psf (299 Pa)	Passed
Water Vapor Transmission	ASTM E 96 Procedure B	Vapor permeable	EPS 5 perm-inch Base Coat* 40 Perms

			Finish** 40 Perms
* Base Coat perm value based on Dryvit Genesis® ** Finish perm value based on Dryvit Quarzputz			

b. Structural

TEST	TEST METHOD	CRITERIA	RESULTS
Tensile Bond	ASTM C 297/E 2134*	Minimum 15 psi (104 kPa) substrate or insulation failure	Minimum 19.1 psi (132 kPa)
Transverse Wind Load	ASTM E 330*	Withstand positive and negative wind loads as specified by the building code	Minimum 90 psf (4.3 kPa)[1] 16 in o.c. framing, 1/2 in sheathing screw attached at 8 in (203 mm) o.c.
* ASTM E 2568 Standard Specification for PB Exterior Insulation and Finish Systems 1. All Dryvit components remain intact – for higher wind loads contact Dryvit Systems, Inc.			

c. Impact Resistance: In accordance with ASTM E 2486* (formerly EIMA Standard 101.86).

Reinforcing Mesh[1]/Weight oz/yd² (g/m²)	Minimum Tensile Strengths	EIMA Impact Classification	EIMA Impact Range in-lbs	(Joules)	Impact Test Results in-lbs	(Joules)
Standard Plus - 6 (203)	200 lbs/in (36 g/cm)	Medium	50-89	(6-10)	56	(6)
Detail Mesh® Short Rolls - 4.3 (146)	150 lbs/in (27 g/cm)	n/a	n/a	n/a	n/a	n/a
Corner Mesh™ - 7.2 (244)	274 lbs/in (49 g/cm)	n/a	n/a	n/a	n/a	n/a
* It shall be colored blue and bear the Dryvit logo for product identification						

d. Fire performance

TEST	TEST METHOD	CRITERIA	RESULTS
Fire Resistance	ASTM E 119	No effect on the fire resistance of a rated wall assembly	Passed 1 & 2 hour non-load bearing
			Passed 2-hour load bearing over wood framing
Ignitability	NFPA 268*	No ignition at 12.5 kw/m^2 at 20 minutes	Passed
Full Scale Multi-Story Fire Test	UBC Std. 26-4 (formerly 17-6)	1. Resist vertical spread of flame within the core of	Passed over steel framing

		the panel from one story to the next 2. Resist flame propagation over the exterior surface 3. Resist spread of vertical flame over the interior surface from one story to the next 4. Resist significant lateral spread of flame from the compartment of fire origin to adjacent spaces	and wood framing
Intermediate Multi-Story Fire Test	NFPA 285* (UBC 26-9)	1. Resist flame propagation over the exterior surface 2. Resist vertical spread of flame within combustible core/component of panel from one story to the next 3. Resist vertical spread of flame over the interior surface from one story to the next 4. Resist lateral spread of flame from the compartment of fire origin to adjacent spaces	Passed
Full Scale Multi-Story[1] (corner test)	ANSI FM 4880	Resist flame propagation over the exterior surface.	Passed; No height restrictions*
* ASTM E 2568 Standard Specification for PB Exterior Insulation and Finish Systems [1] Dryvit FM products must be specified			

2. The Outsulation components shall be tested for:
   a. Fire

TEST	TEST METHOD	CRITERIA	RESULTS
Surface Burning Characteristics	ASTM E 84*	All components shall have a: Flame Spread $\leq$ 25 Smoke Developed $\leq$ 450	Passed
* ASTM E 2568 Standard Specification for PB Exterior Insulation and Finish Systems			

   b. Durability

TEST	TEST METHOD	CRITERIA	RESULTS
Reinforcing Mesh Alkali Resistance of Reinforcing Mesh	ASTM E 2098*	> 120 pli (21dN/cm) retained tensile strength after exposure	Passed
EPS (Physical Properties) Density	ASTM C 303, D 1622	0.95-1.25 lb/ft^3 (15.2-20.0 kg/m^3)	Passed
Thermal Resistance	ASTM C 177, C	4.0 @ 40 °F (4.4 °C)	Passed

	518	3.6 @ 75 °F (23.9 °C)	Passed
Water Absorption	ASTM C 272	2.5 % max. by volume	Passed
Oxygen Index	ASTM D 2863	24% min. by volume	Passed
Compressive Strength	ASTM D 1621 Proc. A	10 psi (69 kPa) min.	Passed
Flexural Strength	ASTM C 203	25 psi (172 kPa) min.	Passed
Flame Spread Smoke Developed	ASTM E 84* ASTM E 84*	25 max. 450 max.	Passed Passed
* ASTM E 2568 Standard Specification for PB Exterior Insulation and Finish Systems.			

1.05 SUBMITTALS

A. Product Data – The contractor shall submit to the owner/architect the manufacturer's product data sheets describing products, which will be used on this project.

B. Shop Drawing for Panelized Construction: The panel fabricator shall prepare and submit to the owner/architect complete drawings, showing: wall layout, connections, details, expansion joints and installation sequence.

C. Samples: The contractor shall submit to the owner/architect two (2) samples of the Outsulation System for each finish, texture and color to be used on the project. The same tools and techniques proposed for the actual installation shall be used. Samples shall be of sufficient size to accurately represent each color and texture being utilized on the project.

D. Test Reports – When requested, the contractor shall submit to the owner/architect copies of selected test reports verifying the performance of the Outsulation System.

E. Environmental Product Declaration: When requested, the contractor shall submit to the owner/architect copies of the Environmental Product Declaration (EPD) describing the estimated environmental impacts of the Outsulation System.

1.06 QUALITY ASSURANCE

A. Qualifications

1. System Manufacturer: Shall be Dryvit Systems, Inc. All materials shall be manufactured or sold by Dryvit and shall be purchased from Dryvit or its authorized distributors.
   a. Materials shall be manufactured at a facility covered by a current ISO 9001:2008 and ISO 14001:2004 certification. Certification of the facility shall be done by a registrar accredited by the American National Standards Institute, Registrar Accreditation Board (ANSI-RAB).
2. Contractor: Shall be knowledgeable in the proper installation of the Dryvit Outsulation System and shall be experienced and competent in the installation of Exterior Insulation and Finish Systems. Additionally, the contractor shall possess a current Outsulation System Trained Contractor Certificate* issued by Dryvit Systems, Inc.
3. Insulation Board Manufacturer: Shall be listed by Dryvit Systems, Inc., shall be capable of producing the Expanded Polystyrene (EPS) in accordance with current Dryvit Specification for Insulation Board, DS131, and shall subscribe to the Dryvit Third Party Certification and Quality Assurance Program.
4. Panel Fabricator: Shall be a contractor experienced and competent in the fabrication of architectural wall panels and shall possess a current Outsulation System Contractor Certificate* issued by Dryvit Systems, Inc.
5. Panel Erector: Shall be experienced and competent in the installation of architectural wall panel systems and shall be:
   a. The panel fabricator, or
   b. An erector approved by the panel fabricator or
   c. An erector under the direct supervision of the panel fabricator

B. Regulatory Requirements

1. The EPS shall be separated from the interior of the building by a minimum 15-minute thermal barrier.
2. The use and maximum thickness of EPS shall be in accordance with the applicable building codes.

C. Certification
1. The Outsulation System shall be recognized for the intended use by the applicable building code(s).

D. Mock-Up
1. The contractor shall, before the project commences, provide the owner/architect with a mock-up for approval.
2. The mock-up shall be of suitable size as required to accurately represent the products being installed, as well as each color and texture to be utilized on the project.
3. The mock-up shall be prepared with the same products, tools, equipment and techniques required for the actual application. The finish used shall be from the same batch that is being used on the project.
4. The approved mock-up shall be available and maintained at the job site.
5. For panelized construction, the mock-up shall be available and maintained at the panel fabrication location.

1.07 DELIVERY, STORAGE AND HANDLING

A. All Dryvit materials shall be delivered to the job site in the original, unopened packages with labels intact.

B. Upon arrival, materials shall be inspected for physical damage, freezing or overheating. Questionable materials shall not be used.
1. Materials shall be stored at the job site, and at all times, in a cool, dry location, out of direct sunlight, protected from weather and other sources of damage. Minimum storage temperature shall be as follows:
a. DPR, PMR™, HDP™, Weatherlastic® and E™ Finishes, Color Prime™, Primus®, Genesis® and NCB™:
40 °F (4 °C).
b. For other products, refer to specific product data sheets.
2. Maximum storage temperature shall not exceed 100 °F (38 °C). NOTE: Minimize exposure of materials to temperatures over 90 °F (32 °C). Finishes exposed to temperatures over 110 °F (43 °C) for even short periods may exhibit skinning, increased viscosity and should be inspected prior to use.

C. Protect all products from inclement weather and direct sunlight.

1.08 PROJECT CONDITIONS

A. Environmental Requirements
1. Application of wet materials shall not take place during inclement weather unless appropriate protection is provided. Protect materials from inclement weather until they are completely dry.
2. At the time of Dryvit product application, the air and wall surface temperatures shall be from 40 °F (4 °C) minimum to 100 °F (38 °C) maximum for the following products:
a. DPR, PMR, HDP, Weatherlastic and E Finishes™, Color Prime, Primus, Genesis and NCB.
b. For other products, refer to specific product data sheets.
3. These temperatures shall be maintained with adequate air ventilation and circulation for a minimum of
24 hours (48 hours for Weatherlastic Finishes, Ameristone, TerraNeo and Lymestone) thereafter, or until the products are completely dry. Refer to published product data sheets for more specific information.

B. Existing Conditions - The contractor shall have access to electric power, clean water, and a clean work area at the location where the Dryvit materials are to be applied.

1.09 SEQUENCING AND SCHEDULING

A. Installation of the Outsulation System shall be coordinated with other construction trades.
B. Sufficient manpower and equipment shall be employed to ensure a continuous operation, free of cold joints, scaffold lines, texture variations, etc.

1.10 LIMITED MATERIALS WARRANTY

A. Dryvit Systems, Inc. shall provide a written limited materials warranty against defective material upon written request. Dryvit shall make no other warranties, expressed or implied. Dryvit does not warrant workmanship. Full details are available from Dryvit Systems, Inc.
B. The applicator shall warrant workmanship separately. Dryvit shall not be responsible for workmanship associated with installation of the Outsulation System.

1.11 DESIGN RESPONSIBILITY

A. It is the responsibility of both the specifier and the purchaser to determine if a product is suitable for its intended use. The designer selected by the purchaser shall be responsible for all decisions pertaining to design, detail, structural capability, attachment details, shop drawings and the like. Dryvit has prepared guidelines in the form of specifications, installation details and product data sheets to facilitate the design process only. Dryvit is not liable for any errors or omissions in design, detail, structural capability, attachment details, shop drawings, or the like, whether based upon the information prepared by Dryvit or otherwise, or for any changes which purchasers, specifiers, designers, or their appointed representatives may make to Dryvit's published comments.

1.12 MAINTENANCE

A. Maintenance and repair shall follow the procedures noted in Dryvit Outsulation Application Instructions, DS204.
B. All Dryvit products are designed to require minimal maintenance. However, as with all building products, depending on location, some cleaning may be required. See Dryvit publication DS152 on Cleaning & Recoating.
C. Sealants and flashings should be inspected on a regular basis and repairs made as necessary.

PART II – PRODUCTS

2.01 MANUFACTURER

A. All components of the Outsulation System shall be supplied or obtained from Dryvit or its authorized distributors. Substitutions or additions of materials other than specified will void the warranty.

Other acceptable manufacturers systems:

BASF – Senerflex Secondary Weather Barrier Design
Sto Corp – Sto Therm ci Essence

2.02 MATERIALS

A. Portland Cement: Shall be Type I or II, meeting ASTM C 150, white or gray in color, fresh and free of lumps.
B. Water: Shall be clean and free of foreign matter.
C. Mechanical Fasteners (required when installing in accordance with DS135): Shall be Wind-lock's Wind Devil™ plates, or equivalent, used in conjunction with corrosion resistant fasteners appropriate for the substrate system.

2.03 COMPONENTS

A. Flashing Materials: Used to protect substrate edges at terminations.
   1. Liquid Applied: An extremely flexible water-based polymer material, ready for use.
      a. Shall be AquaFlash and AquaFlash Mesh
   2. Sheet Type:
      a. Shall be Flashing Tape and Surface Conditioner
         1) Dryvit Flashing Tape™: A high density polyethylene film backed with a rubberized asphalt adhesive available in rolls 4 in (102 mm), 6 in (152 mm) and 9 in (229 mm) wide by 75 ft (23 m) long.
         2) Dryvit Flashing Tape Surface Conditioner™: A water-based surface conditioner and adhesion promoter for the Dryvit Flashing Tape.

B. Air/Water-Resistive Barrier Components (when specified):
   1. Dryvit Backstop NT: A flexible, polymer-based noncementitious water-resistive coating and air barrier available in Texture and Smooth. See DS180 and DS181; DS830 and DS831.
   2. Dryvit Grid Tape™: An open weave fiberglass mesh tape with pressure sensitive adhesive available in rolls 4 in (102 mm) wide by 100 yds (91 m) long.
   3. Dryvit Backstop DMS: A sprayable single step water-resistive membrane/air barrier and adhesive. See DS704.

   NOTE: Backstop DMS is not approved for use over wood based substrates.

C. Adhesives: Used to adhere the EPS to the substrate, shall be compatible with the substrate and the EPS.
   1. Cementitious: A liquid polymer-based material, which is field mixed with Portland cement for use over non wood-based substrates.
      a. Shall be Primus®, Genesis® or Genesis® FM
   2. Ready mixed: A dry blend cementitious, copolymer-based product, field mixed with water for use over non wood-based substrates.
      a. Shall be Primus® DM, Genesis® DM, Genesis® DMS, Rapidry DM 35-50 or Rapidry DM 50-75.
   3. Noncementitious: A factory-mixed, fully formulated water-based adhesive for use over wood-based substrates.
      a. Shall be ADEPS®.

D. Insulation Board: Expanded polystyrene meeting Dryvit Specification for Insulation Board, DS131.
   1. Thickness of insulation board shall be minimum 3/4 in (19 mm) and shall be maintained at all locations. Note: Dryvit recommends that a minimum of 1 in (25 mm) thick insulation board be installed to maintain the minimum thickness after rasping, reveals are installed, etc.
   2. The insulation board shall be manufactured by a board supplier listed by Dryvit Systems, Inc.

E. Base Coat: Shall be compatible with the EPS insulation board and reinforcing mesh(es).
   1. Cementitious: A liquid polymer-based material, which is field mixed with Portland cement.
      a. Shall be Primus, Genesis or Genesis FM.
   2. Noncementitious: A factory-mixed, fully formulated, water-based product.
      a. Shall be NCB™.
   3. Ready mixed: A dry blend cementitious, copolymer-based product, field mixed with water.
      a. Shall be Primus DM, Genesis DM, Genesis DMS, Rapidry DM 35-50 or Rapidry DM 50-75.

F. Reinforcing Mesh: A balanced open weave, glass fiber fabric treated for compatibility with other system materials. Note: Reinforcing meshes are classified by impact resistance and specified by weight and tensile strength as Section 1.04.D.1.c.

1. Shall be Standard, Standard Plus, Intermediate, Panzer 15, Panzer 20, Detail and Corner Mesh.

G. Finish: Shall be the type, color and texture as selected by the architect/owner and shall be one or more of the following:
   1. Elastomeric DPR (Dirt Pickup Resistance): Water-based elastomeric acrylic coating with integral color and texture and formulated with DPR chemistry:
      a. Weatherlastic® Sandpebble
      b. Weatherlastic® Sandpebble Fine
   2. Color Selections: 105 (Dark Beige - Accent), 107(Light Beige – Field), 31301-130TSW (Dark Yellow), 31308-80130 TSW (Light Yellow), 35220 (Dark Blue), 35210 (Light Blue). Submit Color selection chart to make final selections.

PART III – EXECUTION

3.01 EXAMINATION

A. Prior to installation of the Outsulation System, the contractor shall verify that the substrate:
   1. Is of a type listed in Section 1.04.C.1.
   2. Is flat within 1/4 in (6.4 mm) in a 4 ft (1.2 m) radius.
   3. Is sound, dry, connections are tight, has no surface voids, projections or other conditions that may interfere with the Outsulation System installation or performance.

B. Prior to the installation of the Outsulation System, the architect or general contractor shall insure that all needed flashings and other waterproofing details have been completed, if such completion is required prior to the Outsulation application. Additionally, the Contractor shall ensure that:
   1. Metal roof flashing has been installed in accordance with the manufacturer's requirements, Asphalt Roofing Manufacturers Association (ARMA) Standards and Dryvit Outsulation System Installation Details, DS107, or as otherwise necessary to maintain a watertight envelope.
   2. Openings are flashed in accordance with the Outsulation System Installation Details, DS107, or as otherwise necessary to prevent water penetration.
   3. Chimneys, balconies, and decks have been properly flashed.
   4. Windows, doors, etc. are installed and flashed per manufacturer's requirements and the Outsulation System Installation Details, DS107.

C. Prior to the installation of the Outsulation System, the contractor shall notify the general contractor, and/or architect, and/or owner of all discrepancies.

3.02 PREPARATION

A. The Outsulation materials shall be protected by permanent or temporary means from inclement weather and other sources of damage prior to, during, and following application until completely dry.

B. Protect adjoining work and property during Outsulation installation.

C. The substrate shall be prepared as to be free of foreign materials, such as, oil, dust, dirt, form release agents, efflorescence, paint, wax, water repellants, moisture, frost and any other condition that inhibit adhesion.

3.03 INSTALLATION

A. The system shall be installed in accordance with the current Dryvit Outsulation System Application Instructions, DS204.

B. The overall minimum base coat thickness shall be sufficient to fully embed the mesh. The recommended method is to apply the base coat in two (2) passes.

C. Sealant shall not be applied directly to textured finishes or base coat surfaces. Dryvit Outsulation System base coat surfaces in contact with sealant shall be coated with Demandit Smooth or Color Prime.

D. When installing the Outsulation System, the notched trowel method of adhesive application shall be used over gypsum sheathing substrates.
E. High impact meshes shall be installed as specified at ground level, high traffic areas and other areas exposed to or susceptible to impact damage.

3.04 FIELD QUALITY CONTROL

A. The contractor shall be responsible for the proper application of the Outsulation materials.
B. Dryvit assumes no responsibility for on-site inspections or application of its products.
C. If required, the contractor shall certify in writing the quality of work performed relative to the substrate system, details, installation procedures, workmanship and as to the specific products used.
D. If required, the EPS supplier shall certify in writing that the EPS meets Dryvit's specifications.
E. If required, the sealant contractor shall certify in writing that the sealant application is in accordance with the sealant manufacturer's and Dryvit's recommendations.

3.05 CLEANING

A. All excess Outsulation System materials shall be removed from the job site by the contractor in accordance with contract provisions and as required by applicable law.
B. All surrounding areas, where the Outsulation System has been installed, shall be left free of debris and foreign substances resulting from the contractor's work.

3.06 PROTECTION

A. The Outsulation System shall be protected from inclement weather and other sources of damage until dry and permanent protection in the form of flashings, sealants, etc. are installed.

END OF SECTION

SECTION 07410 - PREFORMED ROOFING AND SIDING

PART 1 - GENERAL

RELATED DOCUMENTS:
Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:
Extent of each type of preformed roofing and siding is indicated on the drawings and by provisions of this section. Provide exposed flashing gutters and trim to match. Preformed roofing/siding is hereby defined to include panels which are structurally capable of spanning between supports spaced as indicated.

The types of panels required include the following:
Formed sheet panels, intended for lapped seam installation.

QUALITY ASSURANCE:
Field Measurements: Where possible, prior to fabrication of prefabricated panels, take field measurements of structure or substrates to receive panel system. Allow for trimming panel units where final dimensions cannot be established prior to fabrication.

SUBMITTALS:
Product Data: Submit manufacturer's product specifications, standard details, certified product test results, installation instructions and general recommendations, as applicable to materials and finishes for each component and for total system of preformed panels.

Metal roof system must be tested in accordance with ASTM E 1592-95 for negative loading. Determine panel bending and clips-to-panel strength by testing in accordance with ASTM E 1592-95 procedures.

Samples: Submit 2 samples 12" square, of each exposed finish material.

Shop Drawings: Submit small scale layouts of panels on walls and roofs, and large scale details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim, flashings, closures, and special details. Distinguish between factory and field assembly work.

Submit documentation panel assemblies have been tested in compliance with Structural Engineer Design Pressures and Texas Department of Insurance Guidelines.

WARRANTY:
Owner shall receive one (1) warranty from manufacturer of roof panels covering all of the following criteria. Multiple warranties are not acceptable.

1. Manufacturer’s 15 + 15 year watertight warranty, including coverage for all trim, flashings, and penetrations associated with the roof area.
2. 20 year coverage on finish including checking, crazing, peeling, chalking, fading and/or adhesion.
3. 20 year material coverage.
4. Warranty shall commence on date of substantial completion or final payment, whichever is agreed by contract.

The Contractor, in writing, will guarantee the job to manufacturer for two (2) years from the date of acceptance by the Owner and the Roofing System Manufacturer.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS:
Available Manufacturers: Subject to compliance with requirements, manufacturers offering preformed roofing and siding products which may be incorporated in the work include, but are not limited to the following:

METAL SIDING:

(A) Building Wall Panels: to be equal to MBCI Small Batten panels Craftsman Series SB-12, vertical installation. Pre-finished metal 24 gauge hot dipped galvanized steel ASTM A446-85. Finish shall be Kynar 500 Fluorocarbon at wall surfaces. (Color: Slate Gray – Submit Color Selection Chart for final selection)

(B) Canopy Panels: Equal to MBCI Classic Series P-16 Panels, 24 ga. pre-finished with Kynar 500 finish at all surfaces. (Color: Slate Gray – Submit Color Selection Chart for final selection)

(C) Metal gutter and Downspouts: to be pre-finished metal with Kynar 500 finish at all surfaces. Match finish at all trims, accessories exposed to view. (Color: Slate Gray – Submit Color Selection Chart for final selection)

SHEET MATERIALS:
Steel for Painting/Coating: Hot dip coated steel sheet, ASTM A446, Grade A except where higher strength required for performance, G90 zinc coating, surface treated for maximum coating performance.

METAL FINISHES:
General: Apply coatings either before or after forming and fabricating panels, as required by coating process and as required for maximum coating performance capability. Protect coating promptly after application and cure, by application of strippable film or removable adhesive cover, and retain until installation has been completed. Provide colors or color matches as indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors.

Flouropolymer Coating: Full strength 70% "Kynar 500" coating baked on for 15 minutes at 450 degrees F. (232 degree C), in a dry film thickness of 1.0 mil, 30% reflective gloss (ASTM D523), over min. 0.2 mil baked on modified epoxy primer.

Warranty: Owner shall receive one (1) warranty from manufacturer of roof panels covering all of the following criteria. Multiple warranties are not acceptable.

1. Manufacturer’s 15 + 15 year watertight warranty, including coverage for all trim, flashings, and penetrations associated with the roof area.
2. 20 year coverage on finish including checking, crazing, peeling, chalking, fading and/or adhesion.
3. 20 year material coverage.
4. Warranty shall commence on date of substantial completion or final payment, whichever is agreed by contract.

The Contractor, in writing, will guarantee the job to manufacturer for two (2) years from

the date of acceptance by the Owner and the Roofing System Manufacturer.

MISCELLANEOUS MATERIALS:
Internal Panel Framing: Manufacturer's standard, as required for 100 MPH wind loading.

Fasteners: Manufacturer's standard non-corrosive types, with exterior heads gasketed.

Seam Lock: Wall Panels are required to have optional seam lock feature to comply with wind loading requirements.

Accessories: All exposed fascia, metal trim shall match metal roof color. Except as indicated as work of another specification section, provide components required for a complete roofing/siding system, including trim, copings, fascias, gravel stops, mullions, sills, corner units, ridge closures, clips, seam covers, battens, flashings, gutters, louvers, sealants, gaskets, fillers, closure strips and similar items. Match materials/finishes of preformed panels.

Membrane over Plywood Substrate: Acceptable Product: Sharkskin Ultra SA™ as manufactured by: Kirsch Building Products LLC, 1464 Madera Road, Suite 387, Simi Valley, CA 93065; Tel: (805) 750-0084 Fax: 805-526-1116; www.sharkskin.us.

Provide a self-adhered roof underlayment that has passed the requirements set forth in ICC/ES Report 1708 and Miami/Dade TAS 103.

PANEL FABRICATION; PERFORMANCES:
General: Fabricate and finish panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, and as required to fulfill indicated performance requirements which have been demonstrated by factory testing. Comply with indicated profiles and dimensional requirements, and with structural requirements. Provide only full length sheets.

Metal Gages: Thicknesses shall be 24 gage.

Required Performances: Fabricate panels and other components of roof/wall system for the following installed as indicated performances:

Water Penetration: No significant, uncontrolled leakage at 4 lbs. per sq. ft. pressure with spray test.

Air Infiltration: 0.02 cfm per sq. ft. for gross roof/wall areas, with 4 lbs. per sq. ft. differential pressure.

Apply bituminous coating or other permanent separation materials on concealed panel surfaces where panels would otherwise be in direct contact with substrate materials which are non-compatible or could result in corrosion or deterioration of either material or finishes.

Condensation: Fabricate panels for control of condensation, including proper inclusion of seals and provisions for breathing, venting, weeping and draining.

PART 3 - EXECUTION
INSTALLATION:

General: Comply with panel fabricator's and material manufacturers' instructions and recommendations for installation, as applicable to project conditions and supporting substrates. Anchor panels and other components of the work securely in place, with provisions for thermal/structural movement. Metal roof panels must be installed in accordance with UL 90 Construction method.

Install panels with concealed fasteners.

Installation tolerances: Shim and align panel units within installed tolerance of 1/4: in 20' 0" on level/plumb/slope and location/line as indicated, and within 1/8" offset of adjoining faces and of alignment of matching profiles.

Joint Sealers: Install gaskets, joint fillers and sealants where indicated and where required for weatherproof performance of panel systems. Provide types of gaskets and sealants/fillers indicated or, if not otherwise indicated, types recommended by panel manufacturer.

Refer to other sections of these specifications for product and installation requirements applicable to indicated joint sealers.

Joint Sealers: Refer to other sections of these specifications for post installation requirements on joint sealers; not work of this section.

CLEANING AND PROTECTION:
Damaged Units: Replace panels and other components of the work which have been damaged or have deteriorated beyond successful repair by means of finish touch up or similar minor repair procedures.

Cleaning: Remove temporary protective coverings and strippable films (if any) as each panel is installed. Upon completion of panel installation, clean finished surfaces as recommended by panel manufacturer, and maintain in a clean condition during construction.
END OF SECTION 07410

SECTION 07520 - MODIFIED BITUMINOUS SHEET ROOFING

PART 1 - GENERAL

1. 1 WORK INCLUDED

A. Modified bitumen sheet roofing
B. Flashings

1. 2 RELATED WORK

A. Section 07210 – Roof and Deck Insulation
B. Section 06100 - Rough Carpentry
C. Section 07600 - Flashing and Sheet Metal

1. 3 SYSTEM DESCRIPTION

A. Modified Membrane roofing system: One-ply fiberglass base sheet over tapered insulation fill, One-ply of torch-applied 85-mil thick SBS (styrene-butadiene-styrene) rubber modified base sheet, One-ply of torch-applied 160mil thick SBS rubber, mineral surfaced, dual fiberglass scrim reinforced, modified roof membrane. 160 mil torch-applied SBS mineral surfaced, dual fiberglass scrim reinforced, rubber modified roof membrane flashings.

1. 4 REFERENCES

A. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)Roofing Terminology: Refer to ASTM D 1079 for definitions of terms related to roofing work not otherwise defined in this Section.

ASTM D 41 1994 Asphalt Primer Used in Roofing, Damproofing, and Waterproofing

ASTM D 2178 1997a Asphalt Glass Felt Used in Roofing and Waterproofing.

ASTM D 2822 1997e1 Asphalt Roof Cement.

ASTM D4897-0100 Asphalt Coated Glass Fiber Venting Base Sheet Used in Roofing

ASTM D6163-0100 Styrene Butadiene Styrene (SBS) Modified Bituminous
Sheet Materials Using Glass Fiber Reinforcements

ASTM D5147 2001a Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material.
ASTM E108-00 Test Methods for Fire Test of Roof Coverings.

B. FACTORY MUTUAL GLOBAL RESEARCH, FACTORY MUTUAL APPROVALS0(FMG) .

FM A/S4470 Class 1 Roof Covers

1. 5 REGULATORY REQUIREMENTS

A. Fire Rating: Provide modified bitumen roof system and component materials that have been tested for application and slopes indicated and are listed by Factory Mutual Corporation to comply with Standard No.4470 Approval requirements for Class 1 Fire. and 1-90 Windstorm Classification.
B. Wind Uplift Rating: Complies with IBC (latest version) and Structural Wind

Design Pressures.

C. Provide roof-covering materials bearing Factory Mutual Classification Marking on bundle, package, or container indicating that materials have been produced under FM's Classification and Follow-up Service.

1. 6 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

B. Manufacturer's Certification: The Manufacturer's Certification Form must be signed by a corporate officer of the roofing system manufacturer with the Corporate Seal affixed thereto.

C. Product data for each type of product specified include manufacturer's technical product data, installation instructions, and recommendations for each type of roofing product required. Include data substantiating that materials comply with specified requirements.

D. For all modified bituminous sheet roofing include independent test data according to ASTM Designation D 514797 “Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material”, substantiating that materials comply with specified requirements.

E. Factory Mutual 4470 Certification

F. Samples of the following: Minimum, 3by5inch samples of each colored modified bituminous mineral surfaced cap sheet and flashing materials to be exposed as finished roof surface.

G. Manufacturer's ISO 9001 Certification.

H. Manufacturer's Warranty: Submit sample copy of specified roofing manufacturer's “Thirty (30) Year Warranty".

I. Manufacturer’s Inspection Reports: The Roofing System Manufacturer will provide, when the project is in progress the following:

1. Keeping the Architect informed as to the progress and quality of the work as observed.
2. Provide jobsite inspections at least two (2) times a week.
3. Provide detailed weekly reports to the Architect along with digital photographs of work in progress. All reports and photographs shall be descriptive of actual work in progress and be presented in a pre-approved manner.
4. Reporting to the Architect in writing, any failure or refusal of the Contractor to correct unacceptable practices called to the Contractor's attention.
5. Confirming, after completion of the project and based on manufacturer's observations and tests, that manufacturer has observed no application procedures in conflict with the specifications other than those that may have been previously reported. Submit product data and shop drawings under provisions of Section 01300.

1. 7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Roofing system manufacturer shall be ISO 9001 Certified and have a minimum of 10 years experience in manufacturing modified bitumen roofing products in the United States. Show evidence that the products and materials are manufactured in the United States and that materials provided conform to all requirements specified herein, and are chemically and physically compatible with each other and are suitable for inclusion within the total roof system specified herein.

B. Installer Qualifications: Installer (Roofer) shall be specializing in Built-up bituminous roof application with minimum 5 years experience and who is currently authorized by modified bituminous sheet roofing system manufacturer as qualified to install manufacturer's roofing materials. Any one or more of the following causes may be considered sufficient for the disqualification of installer:
   1. Lack of responsibility as revealed by either financial, experience or equipment statements.
   2. Lack of expertise as shown by past work and judged from the standpoint of workmanship and performance history.
   3. Uncompleted work under other contracts which, in the judgment of the Owner, might hinder or prevent the prompt completion of additional work if awarded.
   4. Being in arrears on existing contracts, in litigation with an Owner, or having defaulted on a previous contract.

C. Installer's Field Supervision: Installer to maintain a full-time supervisor/foreman on job site during all phases of modified bituminous sheet roofing work and at any time roofing work is in progress, proper supervision of workmen shall be maintained. A copy of the Specifications shall be in the possession of the supervisor/foreman at all times.

D. Pre-application Roofing Conference:0Before scheduled commencement of modified bitumen sheet roofing installation and associated work, meet at Project site with Installer, installer of each component of associated work, installers of deck or substrate construction to receive roofing work, installers of rooftop units and other work in and around roofing that must precede or follow roofing work (including mechanical work if any), Architect, Owner, roofing system manufacturer's representative, and other representatives directly concerned with performance of the Work, including test agencies, and governing authorities. Review foreseeable methods and procedures related to roofing work, including but not necessarily limited to the following:
   1. Tour representative areas of roofing substrates (decks), inspect and discuss condition of substrate, roof drains, curbs, penetrations, and other preparatory work.
   2. Review roofing system requirements (drawings, specifications, and other contract documents).
   3. Review required submittals, both completed and yet to be completed.
   4. Review and finalize construction schedule related to roofing work and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   5. Review required inspection, testing, certifying, and material usage accounting procedures.
   6. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including possibility of temporary roofing (if not a mandatory requirement).
   7. Record (Contractor) discussions of conference, including decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

1. 8 EQUIPMENT SAFEGUARDS

A. Proper equipment is to be used to heat roofing membranes. Torches should be equipped with a pilot adjustment, flame height adjustment, 25 to 50 ft. of Approved or listed hose, pressure gauge and regulator. A spark igniter should be used. Torch trolleys and multiple torch head machines should be equipped with listed safety valves.

B. Safety caps are to be tied to all propane cylinders and installed on the valves whenever cylinders are not in use. Carts used to transport propane cylinders should be stable. Tall, narrow, standing cylinders should be chained against walls or in proper carts.

C. The propane cylinder should be adequately sized for the torch used. If frost buildup occurs on propane cylinders and the rate of vapor withdrawal is no longer adequate for operating conditions, the cylinder should not be placed on its side or heated with the torch flame. The hose should be disconnected and a larger cylinder used. Liquid propane cylinders may be of either the vapor withdrawal or liquid withdrawal type. With the vapor withdrawal type, vapor is drawn off from the torch head. Vapor withdrawal cylinders are equipped with female cylinder valves. Liquid withdrawal cylinders transfer the liquid, via a siphon tube, from the cylinder to the torch head where it is vaporized. Liquid withdrawal cylinders have male cylinder valves, which may be equipped with adapters.

D. Frost buildup only occurs with vapor withdrawal cylinders. This buildup can be the result of an undersized cylinder or low air temperatures. When vapor is dawn off more quickly than it is replaced, heat is absorbed and frost buildup occurs on the outside of the cylinder. Vapor pressure then further declines. Consequently, liquid withdrawal cylinders are preferred. However, if vapor withdrawal cylinders are used, or if the temperatures are low (below 20°F, -7°C), 40 or 100 lb (18.2 or 45.5 kg) cylinders should be used with larger torches (such as those used in the field of the roof).

E. Equipment should be thoroughly inspected and repaired or replaced as needed. Propane cylinders should be inspected for dents. If dents larger than 1 in. (25 mm) in diameter are found, the cylinder should be replaced. Torch and cylinder connectors should be visually inspected and checked for leaks with soap and water solution. An open flame should not be used to test for leaks.

F. Leaky equipment should not be used. Regulators adjustments and pressure gauges should be checked to assure they are operable. The vent on the regulator should be checked to assure it is not blocked. If an unstable flame occurs (one which roars loudly and tends to blows itself out), the equipment should be repaired or replaced immediately.

G. Propane cylinders should not be hoisted by their valves. Straps placed around the cylinders should be utilized.

H. A fire watch should be conducted for at least one hour after torch work has been completed. All roof areas worked on should be checked for hot spots and signs of smoldering. If available, infrared roof scanners should be used. The inside of the building should also be inspected for signs of fire and smoke. All “hot spots” or fires, even if extinguished, should be reported to the fire department. Smoldering may continue after extinguishment, may take place for hours before flaming begins, and may take place in areas unsuspected by the layman.

1. 9 FIRE EXTINGUISHING EQUIPMENT

A. There should be at least one 10 lb (4.5 kg) multipurpose dry chemical

portable extinguisher within 20 ft. (6.1 m) horizontal travel distance of torch-applied roofing equipment. For large roof areas, additional protection such as charged hose lines or additional extinguishers should be provided as practical.

1.10 FUEL HANDING SAFEGUARDS

A. Fuel containers, burners and related appurtenances of roofing equipment in which liquefied petroleum gas is used for heating should comply with NFPA58, *Standard for Storage and Handling of Liquefied Petroleum Gases.*

B. All fuel containers should be located at least 10 ft. (3 m) from the burner flame or at least 2 ft. (0.6 m) away when properly insulated from heat or flame.

1.11 INSTALLATION SAFEGUARDS

A. The flame from a hand-held torch should be constantly moved from side to side. The exposed outer surface of the membrane coil should be heated until a slight sheen develops.

B. Caution should be used when working around roof openings, penetrations or flashings. Wood nailers, cant strips and metal flashing should not come in direct contact with the flame of the torch. Small detail torches should be used to heat the underside of the membrane away from these areas before securement.

C. The torch should not be used in areas where the flame impingement cannot be fully viewed. Back-heat and flop the material when flame is not visible.

D. Extreme caution is to be used near penetrations such as exhaust vents. Air conditioning units and ventilating fans should be shut down before torch work is done in surrounding areas.

E. Feather seams around details with heated trowel.

F. Expansion joints should be filled with mineral wool or ceramic fiber with a steel cover plate below.

G. No full-time torches should be used under any circumstances.

H. A torch stand is to be used to direct the flame upward when momentarily not in use.

I. The cylinder valve should be closed to burn off propane in the line before shutting of the torch head. The gas supply should be shut off whenever a propane odor is detected.

J. Torches should not be used near gas lines, electrical wires or flammable liquids during roof construction.

K. When foam plastic, kraft-faced glass fiber or wood fiber insulation or cant strips, or plastic fasteners are to be used, they should be covered with a minimum 40 lb base sheet adhered with hot asphalt before the torch applied membrane is installed.

L. Torch flames should not come in contact with exposed plastic roofing cement.

1.12 WARRANTY

A. Manufacturer's Warranty: “Thirty (30) year Warranty", signed by a corporate officer of the corporation of modified bitumen sheet roofing system manufacturer, will pay all authorized cost or repair to the roof membrane system necessary to stop any leaks which occur during a Thirty (30) year period from the date of completion. Leaks which occur only as a result of the following will be repaired:

1. Deterioration of the roofing system or flashing system resulting from ordinary wear and tear by the elements.
2. Workmanship on the part of the authorized roofing contractor in the application of the roofing system.
3. Splits or breaks in the roofing system not caused by structural movement or failure or movement of any material underlying the roofing system or base flashing.
4. Blisters, wrinkles, ridges, fishmouths or open laps in the roofing system.
5. Slippage of the roofing system or flashing system.

B. Contractor"s warranty: Provide two year warranty in accordance with Section 01705.

PART 2 - PRODUCTS

2. 1 GENERAL

A. When a particular performance standard is specified, it shall be indicative of a minimum standard required. Products not meeting these minimum performance requirements, shall not be bid and will not be considered.

B. Provide as listed or approved substitution. All request for substitution must be submitted at least 7 DAYS prior to bidding and shall include the Substitution Request Form attached to the end of this Section.

C. Obtain primary products, including each type of roofing sheet, bitumen, membrane flashings from a single manufacturer. Provide secondary products as recommended by manufacturer of primary products for use with roofing system specified.

2. 2 SHEET MATERIALS

A. Fiberglass Base Sheet: ASTM D-4601, Tested in accordance with D 5147 with mineral surfacing that meets the following minimum requirements:

Equal to Firestone Basegard SA Base Sheet

Thickness:	70 mil
Bottom Side Coating	20 mil
Maximum Load:	25 lbf/in.
Elongation:	10%
Tear Resistance	20 lbf
Sealability around Nail	Pass

B. SBS Modified Torch Base Sheet: SBS (styrene-butadiene-styrene), rubber membrane, reinforced with dual fiberglass scrim designed for torching applications, conforming to the following minimum performance requirements according to ASTM D-6164, Type I, Grade S and ASTM D 5147 @ 73° F:

Equal to Firestone SBS Torch Base

	Machine Direction	Cross Machine Direction
Tensile Strength	160 lbf/in.	90 lbf/in.
Elongation at Peak Load	40 %	40 %
Tear Strength	60 lbf	60 lbf
Low Temp. Flex.	Passes -15° F	
Thickness	120 mils	

C. Modified Bitumen Cap Sheet Membrane: mineral surfaced SBS (styrene-butadiene-styrene), rubber modified roof membrane; reinforced with a

dual fiberglass scrim designed for torching applications, conforming to the following minimum performance requirements according to ASTM D-6164, Type II, Grade G and ASTM D-5147 @ 73° F:

Equal to Firestone Premium FR Torch – Ultra White finish

	Machine Direction	Cross Machine Direction
Tensile Strength	75 lbf.	75 lbf
Elongation at Peak Load	55 %	55 %
Tear Strength	75 lbf	75 lbf
Low Temp. Flex.	Passes -15° F	
Thickness	160 mils	
Solar reflectivity	71%	

D. Modified Bitumen Flashing Membrane: mineral surfaced SBS (styrene-butadiene-styrene), rubber modified roof membrane; reinforced with a dual fiberglass scrim designed for torching applications, conforming to the following minimum performance requirements according to ASTM D-6164, Type II, Grade G and ASTM D-5147 @ 73° F:

	Machine Direction	Cross Machine Direction
Tensile Strength	75 lbf.	75 lbf
Elongation at Peak Load	55 %	55 %
Tear Strength	75 lbf	75 lbf
Low Temp. Flex.	Passes -15° F	
Thickness	160 mils	
Solar reflectivity	71%	

2. 3 BITUMINOUS MATERIALS

A. Asphalt Primer: ASTM D 41, V.O.C compliant.

B. Asphalt Roofing Mastic: ASTM D 4586, Type II, V.O.C compliant.

2. 4 CANTS

A. Fiberglass cant strips preformed to a 45 degree angle with nominal horizontal and vertical lengths, as acceptable to the primary membrane manufacturer.

B. Wood Cants: Specified in Section 06100

2. 5 FASTENERS

A. General:

1. Exposed fasteners shall be hex head stainless steel self-tapping screws with stainless steel jacketed neoprene washers.

2. Fasteners shall be compatible with all materials with which they come in contact so that dielectric corrosion does not occur.

B. Base Sheet Fasteners: per test report complying with IBC and Structural Engineer Design Wind Pressures.

2. 6 ACCESSORIES

A. Penetration Seals: Chem Curb System, Chem Link Inc.

B. Protection Pad: Manufacturer's Modified Cap sheet or product approved by membrane manufacturer.

C. Sealant: One component gun-grade sealant, ASTM C-920-87, Federal Specification TT-S-00230-C.

PART 3 - EXECUTION

3. 1 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.
B. Beginning of installation means installer accepts existing surfaces.
C. Verify under deck conditions are clear for fastener installation.

3. 2 GENERAL INSTALLATION REQUIREMENTS

A. Cooperate with manufacturer, inspection and test agencies engaged or required to perform services in connection with installing modified bitumen sheet roofing system.
B. Protect other work from spillage of modified bitumen roofing materials, and prevent liquid materials from entering or clogging drains and conductors. Replace or restore other work damaged by installation of modified bituminous sheet roofing system work.
C. Code Compliance: Where required, install and test modified bitumen sheet roofing system to comply with governing regulations and specified requirements.
D. Coordinate installing roofing system components so that insulation and roofing plies are not exposed to precipitation or left exposed overnight. Provide cut offs at end of each day's work to cover exposed ply sheets and insulation with a course of coated felt with joints and edges sealed with roofing cement. Remove cut offs immediately before resuming work.
E. Apply roofing materials as specified herein unless recommended otherwise by manufacturer's instructions. Keep roofing materials dry before and during application. Do not permit phased construction. Complete application of roofing plies, cap sheet and flashing in a continuous operation. Begin and apply only as much roofing in one day as can be completed that same day.
F. Water Cutoffs: At end of each day's roofing installation, protect exposed edge of incomplete work, including ply sheets and any insulation. Provide temporary covering of one ply of torch base sheet; remove at beginning of next day's work. Seal off flutes in metal decking along cut off edge. Pull membrane free or cut to expose the insulation when resuming work, and remove the insulation sheets used for filling.

3. 3 TORCH BASE SHEET UNDERLAYMENT INSTALLATION

A. Install one layer of SBS Torch Base Sheet to venting base sheet, Shingle in proper direction to shed water on each area of roofing.
B. To the above substrates, lay out the roll in the course to be followed and unroll six (6) feet.
C. Using a roofing torch, heat the surface of the coiled portion until the burn-off backer melts away. At this point, the material is hot enough to lay into the substrate. Progressively unroll the sheet while heating and press down with your foot to insure a proper bond.
D. After the major portion of the roll is bonded, re-roll the first six (6) feet and bond it in a similar fashion.
E. Repeat this operation with subsequent rolls with side laps of four (4) inches and end laps of eight inches.
F. Give each lap a finishing touch by passing the torch along the joint and spreading the melted bitumen evenly with a rounded trowel to insure a smooth, tight seal.
G. Extend underlayment two (2) inches beyond top edges of cants at wall and projection bases.

H. Install base flashing ply to all perimeter and projections details.

3. 5 MINERAL SURFACED SBS MODIFIED MEMBRANE APPLICATION

A. Over the SBS Torch Base Sheet underlayment, lay out the roll in the course to be followed and unroll six (6) feet. Seams for the top layer of modified membrane will be staggered over the SBS Torch Base Sheet seams.

B. Using a roofing torch, heat the surface of the coiled portion until the burn-off backer melts away. At this point, the material is hot enough to lay into the substrate. Progressively unroll the sheet while heating and press down with your foot to insure a proper bond.

C. After the major portion of the roll is bonded, re-roll the first six (6) feet and bond it in a similar fashion.

D. Repeat this operation with subsequent rolls with side laps of four (4) inches and end laps of eight (8) inches.

E. Give each lap a finishing touch by passing the torch along the joint and spreading the melted bitumen evenly with a rounded trowel to insure a smooth, tight seal.

3. 6 BASE FLASHING INSTALLATION

A. All base flashings are to be installed and completed on a daily basis. No condition should exist that will permit moisture entering behind, around, or under the roof or flashing membrane.

B. Prepare all walls, penetrations and expansion joints to be flashed and where shown on the drawings, with asphalt primer at the rate of .75 to 1 gallon per square. Allow primer to dry tack free.

C. The heat fused flashing membrane will be adhered to an underlying base ply of Self-Adhering Fire Retardant base sheet where indicated, or Torch Base Sheet nailed off at all vertical surfaces where shown on the drawings.

D. The entire sheet of flashing membrane must be heated to the point when surface bitumen melts and begins to flow. Both surfaces along the lap areas shall be heated. The heated area will immediately be worked into place and securely bonded.

E. Seal all vertical laps of flashing membrane with an additional ply of 8inch wide flashing membrane. All laps must be tested with a round nosed trowel putting pressure against the side lap to insure that a complete, positive bond has been achieved and to protect against a superficially closed lap.

F. After the laps have been tested, and a complete positive bond has been achieved, the applicator shall heat the seam edge and trowel along the seam edge. Troweling shall continue until a sloped, beveled edge has been produced.

G. Secure top of flashing membrane with termination bar and fasten 8 inches o. c.

H. Factory fabricated flashings, cap flashings and similar work to be coordinated with modified bitumen roofing work are specified in other Sections.

I. Miscellaneous sheet metal accessory items, including piping vents to be coordinated with modified bituminous roofing system work, are specified in other Sections.

3. 7 PROTECTION

A. During execution of work covered by this Section, the Contractor shall

provide protection for equipment, materials, inside and outside the building against falling debris, sparks, and water. Protection shall be provided in a manner to minimize interference, interruption, and inconvenience to other trades.

B. Protect building surfaces against damage from roofing work.

C. All workmen shall wear clean, soft rubbersoled shoes for any application work where they may be walking on the in-place roofing membrane. Precautions shall be taken to protect the membrane and to maintain a clean appearance. Protect roofing during remainder of construction period.

D. At end of construction period, or at a time when remaining construction will in no way affect or endanger roofing, inspect roofing and prepare a written report, with copies to Owner, describing nature and extent of deterioration or damage found.

3. 8 FINAL INSPECTION

A. At completion of roofing installation and associated work, meet with Installer, installer of associated work. Owner, Architect, roofing system manufacturer's representative and other representatives directly concerned with performance of roofing system.

B. Walk roof surface areas of the building, inspect perimeter building edges as well as flashing of roof penetrations, walls, curbs and other equipment. List all items requiring correction or completion and furnish copy of list to each party attending.

C. The Owner, Architect and Roofing System Manufacturer reserve the right to request a certified photographic and recorded thermographic scan of the roof during final inspection to determine if any damp or wet materials have been installed. The thermographic scan and photographic records shall be provided by the Roofing Contractor free of charge.

D. If core cuts verify the presence of damp or wet materials, the Roofing Contractor shall be required to replace the damaged areas at his own expense.

E. Repair or replace (as required) deteriorated or defective work found at time of above inspection to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

F. The Contractor is to notify the Architect upon completion of corrections.

G. Following the final inspection, acceptance will be made in writing by the material manufacturer.

3. 9 CLEANING

A. Remove drippage of the bitumen adhesives from all walls, windows, floors, ladders, and finished surfaces.

B. In areas where finished surfaces are soiled by asphalt or any other source of soiling caused by work of this Section, consult manufacturer of surfaces for cleaning advice and conform to their instructions.

SECTION 07600 - SHEET METAL FLASHING AND TRIM

PART 1 — GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the Conditions of the Contract and Division 01 Specification Sections apply to this section.

1.2 SUMMARY

A. Provide all labor, equipment, and materials to fabricate and install the following.

1. Edge strip and flashing.

2. Fascia and trim.

3. Coping cap at parapets.

4. Fascia and edge metal.

B. Related Work Specified Elsewhere:

1. Division 06 Rough Carpentry

2. Division 07 Modified Bituminous Membrane Roofing

3. Division 07 Roof Accessories

4. Division 07 Roof & Deck Insulation

5. Division 07 Manufactured Metal Roof Panels

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (galvanized) or Zinc-Iron Alloy-Coated (galvannealed) by the Hot-Dip Process.

2. ASTM A792 Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy Coated by the Hot-Dip Process.

3. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

4. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

5. ASTM D692 Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures.

B. American National Standards Institute and Single Ply Roofing Institute (ANSI/SPRI)

1. ANSI/SPRI ES-1 Testing and Certification Listing of Shop Fabricated Edge Metal

C. Warnock Hersey International, Inc., Middleton, WI (WH)

D. Factory Mutual Research Corporation (FMRC)

E. Underwriters Laboratories (UL)

F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

1. Latest Edition Architectural Sheet Metal Manual

2. Roofing and Waterproofing Manual

G. National Roofing Contractors Association (NRCA)

H. American Society of Civil Engineers (ASCE)

1. ASCE 7-05 Minimum Design Loads for Buildings and Other Structures.

1.4 SUBMITTALS FOR REVIEW

A. Product Data:

1. Provide manufacturer's specification data sheets for each product.

2. Metal material characteristics and installation recommendations.

3. Submit color chart prior to material ordering and/or fabrication so that equivalent colors to those specified can be approved.

B. Samples: Submit two (2) samples, illustrating typical metal edge, coping, gutters, fascia extenders for material and finish.

C. Shop Drawings

1. For manufactured and shop fabricated gravel stops, fascia, scuppers, and all other sheet metal fabrications.

2. Indicate material profile, jointing pattern, jointing details, fastening methods, flashing, terminations, and installation details.

3. Indicate type, gauge and finish of metal.

D. Specimen Warranty: Provide an unexecuted copy of the warranty specified for this Project, identifying the terms and conditions required of the Manufacturer and the Owner.

1.5 SUBMITTALS FOR INFORMATION

A. Design Loads: Any material submitted must be accompanied by a report signed and sealed by a professional engineer licensed in the state of Texas. This report shall show that the submitted equal meets the wind uplift and perimeter attachment requirements according to ASCE 7-05 and ANSI/SPRI ES-1. Submitals without licensed engineer approval will be rejected for non-conformance.

B. A letter from an officer of the manufacturing company certifying that the materials furnished for this project are the same as represented in tests and supporting data.

C. Mill production reports certifying that the steel thicknesses are within allowable tolerances of the nominal or minimum thickness or gauge specified.

D. Certification of work progress inspection. Refer to Quality Assurance Article below.

E. Certifications:

1. Submit certification that the perimeter/edge metal products being used on this project have been tested according to ANSI/SPRI ES-1 criteria. Certification submitted must be provided by either NRCA, Independent Test Agency or the perimeter/edge metal manufacturer.

1.6 QUALITY ASSURANCE

A. Engage an experienced roofing contractor specializing in sheet metal flashing work with a minimum of five (5) years experience.

B. Maintain a full-time supervisor/foreman who is on the job-site at all times during installation. Foreman must have a minimum of five (5) years experience with the installation of similar system to that specified.

C. Upon request fabricator/installer shall submit work experience and evidence of financial responsibility. The Owner's representative reserves the right to inspect fabrication facilities in determining qualifications.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened containers or packages with labels intact and legible.

B. Stack pre-formed and pre-finished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials which may cause discoloration or staining.

1.8 PROJECT CONDITIONS

A. Determine that work of other trades will not hamper or conflict with necessary fabrication and storage requirements for pre-formed metal edge system.

1.9 DESIGN AND PERFORMANCE CRITERIA

A. Wind Uplift Pressures: Metal edge system must meet minimum design load pressures as determined by ASCE 7. Provide completed calculations to show ANSI/SPRI ES-1 test results meet the minimum wind uplift pressures.

B. Thermal expansion and contraction:

1. Completed metal edge flashing system shall be capable of withstanding expansion and contraction of components caused by changes in temperature without buckling, producing excess stress on structure, anchors or fasteners, or reducing performance ability.

1.10 WARRANTIES

A. Owner shall receive one (1) warranty from manufacturer covering all of the following criteria. Multiple warranties are not acceptable.

1. Pre-finished metal material shall require a written twenty (20)-year non-prorated warranty covering fade, chalking and film integrity. The material shall not show a color change greater than 5 NBS color units per ASTM D2244 or chalking excess of 8 units per ASTM D659. If either occurs material shall be replaced per warranty, at no cost to the Owner.

2. Changes: Changes or alterations in the edge metal system without prior written consent from the manufacturer shall render the system unacceptable for a warranty.

3. Warranty shall commence on date of substantial completion or final payment, whichever is agreed by contract.

4. The Contractor shall provide the Owner with a notarized written warranty assuring that all sheet metal work including caulking and fasteners to be watertight and secure for a period of (2) two years from the date of final acceptance of the building. Warranty shall include all materials and workmanship required to repair any leaks that develop, and make good any damage to other work or equipment caused by such leaks or the repairs thereof.

PART 2 — PRODUCTS

2.1 PRODUCTS, GENERAL

A. Refer to Division 01 Section "Common Product Requirements."

B. Comply with all manufacturer and contractor/fabricator quality and performance criteria specified in Part 1.

2.3 ACCEPTABLE FABRICATORS

A. Any fabricator which has been certified by the NRCA (National Roofing Contractors Association) to fabricate their ANSI/SPRI ES-1 tested profiles on their Gravel-Stop, Metal Edge, Fascia and Coping Cap products**.**

B. Provide a product carrying a signed and sealed Performance Test Report from a testing company for ANSI/SPRI ES-1 on their Gravel-Stop, Metal Edge, Fascia and Coping Cap products.

C. Any fabricator with a Gravel-Stop, Metal Edge, Fascia and Coping Cap products that has been tested in accordance with ANSI/SPRI ES-1 standards. Proof of this testing must be provided via a report signed and sealed by a qualified third party testing agency. This report shall show that the submitted equal meets the wind uplift and perimeter attachment requirements according to ASCE 7-05 and ANSI/SPRI ES-1. Substitution requests submitted without licensed engineer approval will be rejected for non-conformance

2.4 MATERIALS

A. Materials:

1. Exposed base metal material:

a. Aluminum, ASTM B209, alloy 3105-H14, in thickness of .032" nom. or .040" nom. or .050" nom. or .063" nom.

2. Unexposed base metal material:

a. Zinc-coated steel, ASTM A653, coating designation G-90, in thickness of 0.0299 nom./ 22 gauge, 36" to 48" by coil length, chemically treated, commercial or lock-forming quality.

3. Minimum gauge of steel or thickness of Aluminum to be specified in accordance with Architectural Sheet Metal Manual, Sheet Metal and Air Conditioning Contractor's National Association, Inc. recommendations.

B. Finishes:

1. Exposed surfaces for coated panels:

a. Steel Finishes: fluorocarbon finish. Epoxy primer baked both sides, .2-.25 mils thickness as approved by finish coat manufacturer.

Weathering finish as referred by National Coil Coaters Association (NCCA).

PROPERTY	TEST METHOD	FLUOROCARBON*
Pencil Hardness	ASTM D3363 NCCA II-2	HB-H
Bend	ASTM D-4145 NCCA II-19	O-T
Cross-Hatch Adhesion	ASTM D3359	no loss of adhesion
Gloss (60° angle)	ASTM D523	25+/-5%
Reverse Impact	ASTM D2794	no cracking or loss of adhesion
Nominal Thickness	ASTM D1005	
Primer		0.2 mils
Topcoat		0.8 mils
TOTAL		1.0 mils

* Subject to minimum quantity requirements

b. Color shall match MBCI “Slate Gray” wall panels. Refer to Specification Section 07410.

2. Exposed and unexposed surfaces for mill finish flashing, fascia, and coping cap, shall be as shipped from the mill.

3. Exposed and unexposed surfaces for anodized aluminum flashing, fascia, and coping cap, shall be as shipped from mill.

2.4 RELATED MATERIALS AND ACCESSORIES

A. Metal Primer: Zinc chromate type.

B. Plastic Cement: ASTM D 4586

C. Sealant: Tuff-Stuff One part polyurethane sealant.

D. Underlayment: ASTM D2178, No15 asphalt saturated roofing felt.

E. Slip Sheet: Rosin sized building paper.

F. Fasteners:

1. Corrosion resistant screw fastener as recommended by metal manufacturer. Finish exposed fasteners same as flashing metal.

2. Fastening shall conform to Factory Mutual requirements or as stated on section details, whichever is more stringent.

G. Gutter and Downspout Anchorage Devices: Material as specified for system.

PART 3 — EXECUTION

3.1 EXECUTION, GENERAL

A. Refer to Division 07 Section Common Work Results for Thermal and Moisture Protection.

3.2 PROTECTION

A. Isolate metal products from dissimilar metals, masonry or concrete with bituminous paint, tape, or slip sheet. Use gasketed fasteners where required to prevent corrosive reactions.

3.3 GENERAL

A. Secure fascia to wood nailers at the bottom edge with a continuous cleat.

B. Fastening of metal to walls and wood blocking shall comply with building code standards.

C. All accessories or other items essential to the completeness of sheet metal installation, whether specifically indicated or not, shall be provided and of the same material as item to which applied.

D. Allow sufficient clearances for expansion and contraction of linear metal components. Secure metal using fasteners as required by the system. Exposed face fastening will be rejected.

3.4 INSPECTION

A. Verify that curbs are solidly set and nailing strips located.

B. Perform field measurements prior to fabrication.

C. Coordinate work with work of other trades.

D. Verify that substrate is dry, clean and free of foreign matter.

E. Commencement of installation shall be considered acceptance of existing conditions.

3.5 SHOP-FABRICATED SHEET METAL

A. Metal work shall be shop fabricated to configurations and forms in accordance with recognized sheet metal practices.

B. Hem exposed edges.

C. Angle bottom edges of exposed vertical surfaces to form drip.

D. Lap corners with adjoining pieces fastened and set in sealant.

E. Form joints for gravel stop fascia system, coping cap with a 3/8" opening between sections. Back the opening with an internal drainage plate formed to the profile of fascia piece.

F. Install sheet metal to comply with referenced ANSI/SPRI, SMACNA and NRCA standards.

3.7 CLEANING

A. Clean installed work in accordance with the manufacturer's instructions.

B. Replace damaged work than cannot be restored by normal cleaning methods.

3.8 CONSTRUCTION WASTE MANAGEMENT

A. Remove and properly dispose of waste products generated. Comply with requirements of authorities having jurisdiction

3.09 FINAL INSPECTION

A. At completion of installation and associated work, meet with Contractor, Architect, installer, installer of associated work, Owner, roofing system manufacturer's representative, and other representatives directly concerned with performance of roofing system.

B. Inspect work and flashing of roof penetrations, walls, curbs and other equipment. List all items requiring correction or completion and furnish copy of list to each party in attendance.

C. Repair or replace deteriorated or defective work found at time above inspection as required to a produce an installation which is free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

D. Notify the Contractor upon completion of corrections.

E. Following the final inspection, provide written notice of acceptance of the installation from the roofing system manufacturer.

F. Immediately correct roof leakage during construction. If the Contractor does not respond within twenty-four (24) hours, the Owner will exercise rights to correct the Work under the terms of the Conditions of the Contract.

END OF SECTION

SECTION 07720 - ROOF ACCESSORIES

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: Factory fabricated roof curb adapter.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, materials, dimensions of individual components and profiles, and finishes.

B. Coordination Drawings: Roof plans drawn to scale and coordinating penetrations and roof-mounted items. Show the following:
1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
4. Coordinate dimensions with shop drawings of equipment to be supported.

1.4 QUALITY ASSURANCE

A. Substitutions: Requests for substitution shall be submitted in writing at least 10 days prior to bid date and shall be accompanied by product literature and samples. No substitution will be permitted after bid date.

B. Standards: Comply with the following:
1. SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
2. NRCA's "Roofing and Waterproofing Manual" details for installing units.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. G-90 galvanized steel with paint-grip coating.

B. Insulation: Manufacturer's standard rigid or semirigid glass-fiber board of 2” thickness, 1-1/2lb density, R8 value.

C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches thick.

D. Fasteners: Stainless steel metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.

E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

F. Bituminous Coating: SSPC-Paint 12, solvent-type bituminous mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil dry film thickness per coating.

G. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

H. Elastomeric Sealant: Generic type recommended by unit manufacturer that is compatible with joint surfaces; ASTM C 920, Type S, Grade NS, Class 25, and Uses NT, G, A, and, as applicable to joint substrates indicated, O.

I. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

2.2 ROOF CURBS

A. General: Provide roof curbs capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

B. Fabrication: Unless otherwise indicated or required for strength, fabricate units from minimum 16 gauge, galvanized steel with paint grip coating, with welded corners and with seams joined by continuous water and air-tight welds. Tack or spot welding is unacceptable.
1. All external welds shall be prepared and coated with corrosion inhibitor compound.
2. Curb adapter walls shall be insulated with 1-1/2” thick, three-pound density insulation. Exposed edges shall be encapsulated to ensure no insulation erodes into the air stream. Insulation shall be either foil faced or coated with antimicrobial coating such that the fibers are not airborne over the life of the building.
3. Provide preservative-treated wood nailers at tops of curbs and formed flange at perimeter bottom for mounting to roof.
4. Provide formed cants and base profile coordinated with roof insulation thickness.
5. The Manufacturer shall limit static pressure gain to .25 inches/water gauge
6. Fabricate units to minimum height of 18 inches, unless otherwise indicated.
7. Changes in airflow direction to be accomplished by 90-degree elbows with turning vanes.
8. Curb adapters shall be manufactured in one piece except when width exceeds 108”. If width exceeds 108”, the curb shall be designed with prefabricated joints for ease of installation. It will be manufactured in separate pieces with the number and length of the pieces determined by the total length of the unit. The Manufacturer shall supply drawings for assembly and installation.
9. Curb adapters shall provide full support of the new unit and shall include 3/8” gasketing.
10. Counter flashing shall extend over the original curb a minimum of 1” and be welded and weatherproof.

2.3 FINISHES, GENERAL

A. Surface preparation: Oil, grease and other deposits of surface contamination shall be removed by solvent or detergent washing. All surfaces must be clean, dry and free of any dirt, dust, grease, oil or other deleterious materials prior to coating. Care shall be taken to ensure surfaces remain clean before and during coating process.

B. Application system:
   1. Coating shall provide a standard 5 year manufacturer's limited warranty.
   2. Metal surfaces shall be finished with a corrosion protection system equal to one of the following:
      a. Energy Guard ZRU Primer. Finish coat shall consist of EnergyGuard DCC Cabinet Casing polyurethane coating. Coatings shall be applied by a certified applicator and shall result in a finish with an ASTMB117-90 salt spray rating of 10,000 hours.
      b. Prime coat of ICI Devran 201 Universal Epoxy Primer to thickness of not less than 3.0 mils DFT (dry film thickness) nor more than 8.0 mils DFT. Minimum recoat time for Devran 201 Universal Epoxy Primer is 3.5 hours at 77 F with 80% relative humidity. Finish coat shall consist of Devthane 379 UVA Aliphatic Urethane Gloss Enamel applied to thickness of not less than 1.0 mils DFT nor more than 5.0 mils DFT.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written instructions. Coordinate installation of roof accessories with installation of roof deck, roof insulation, flashing, roofing membranes, penetrations, equipment, and other construction involving roof accessories to ensure that each element of the Work performs properly and that combined elements are waterproof and weather tight. Anchor roof accessories securely to supporting structural substrates so they are capable of withstanding lateral and thermal stresses, and inward and outward loading pressures.

B. Separation: Separate metal from incompatible metal or corrosive substrates, including wood, by coating concealed surfaces, at locations of contact, with bituminous coating or providing other permanent separation.

C. Flange Seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a seal.

D. Cap Flashing: Where required as component of accessory, install cap flashing to provide waterproof overlap with roofing or roof flashing (as counter flashing). Seal overlap with thick bead of mastic sealant.

E. Operational Units: Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

3.2 CLEANING AND PROTECTION

A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

END OF SECTION 07720

SECTION 07724 - ROOF HATCH

I. PART ONE - GENERAL

1.01 SUMMARY

A. Work included: Furnishing and installing factory fabricated roof hatches

B. Related Work:

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM), 100 Bar Harbor Drive, West Conshocken, PA 19428-2959; (610) 832-9585, fax (610) 832-9555

1. ASTM A 36-93a: Standard Specification for Structural Steel

1.03 SUBMITTALS

A. Product Data: Provide manufacturer's product data for all materials in this specification.

B. Shop Drawings: Show profiles, accessories, location, and dimensions.

C. Samples: Manufacturer to provide upon request; sized to represent material adequately.

D. Contract Closeout: Roof hatch manufacturer shall provide the manufacturer's Warranty prior to the contract closeout].

1.04 PRODUCT HANDLING

A. All materials shall be delivered in manufacturer's original packaging.

B. Store materials in a dry, protected, well-vented area. The contractor shall thoroughly inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

C. Remove protective wrapping immediately after installation [if applicable].

1.05 SUBSTITUTIONS

A. Proposals for substitution products shall be accepted only from bidding contractors and not less than (10) working days before bid due date. Contractor guarantees that proposed substitution shall meet the performance and quality standards of this specification.

1.06 JOB CONDITIONS

A. Verify that other trades with related work are complete before installing roof hatch(s).

B. Mounting surfaces shall be straight and secure; substrates shall be of proper width.

C. Refer to the construction documents, shop drawings, and manufacturer's installation instructions.

D. Coordinate installation with roof membrane and roof insulation manufacturer's instructions before starting.

E. Observe all appropriate OSHA safety guidelines for this work.

1.07 WARRANTY/GUARANTEE

A. Manufacturer's standard warranty: Materials shall be free of defects in material and workmanship for a period of five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge. Electrical motors, special finishes, and other special equipment (if applicable) shall be warranted separately by the manufacturers of

those products.

II. PART TWO - PRODUCTS

2.01 MANUFACTURER

A. The BILCO Company, P.O. Box 1203, New Haven, CT 06505, 1-203-934-6363, Fax: 1-203-933-8478, Web: www.bilco.com

2.02 ROOF HATCH

A. Furnish and install where indicated on plans metal roof hatch Type S, size width: 3'0" (914mm) x length: 2'6" (762mm). Length denotes hinge side. The roof hatch shall be single leaf. The roof hatch shall be preassembled from the manufacturer.

B. Performance characteristics:

1. Cover shall be reinforced to support a minimum live load of 40 psf (195kg/m2) with a maximum deflection of 1/150th of the span or 20 psf wind uplift.
2. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
3. Operation of the cover shall not be affected by temperature.
4. Entire hatch shall be weathertight with fully welded corner joints on cover and curb.

C. Cover: Shall be [select: 14 gauge paint bond G-90 galvanized steel or 11 gauge aluminum] with a 3” (76mm) beaded flange with formed reinforcing members. Cover shall have a heavy extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.

D. Cover insulation: Shall be fiberglass of 1” (25.4mm) thickness, fully covered and protected by a metal liner 18 gauge aluminum.

E. Curb: Shall be 12” (305mm) in height and of [select: 11 gauge aluminum. The curb shall be formed with a 3-1/2” (89mm) flange with 7/16” (11.1mm) holes provided for securing to the roof deck. The curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil-ClipTM flashing system, including stamped tabs, 6” (153mm) on center, to be bent inward to hold single ply roofing membrane securely in place.

F. Curb insulation: Shall be rigid, high-density fiberboard of 1” (25.4mm) thickness on outside of curb.

G. Lifting mechanisms: Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe welded to the curb assembly.

H. Hardware

1. Heavy pintle hinges shall be provided
2. Cover shall be equipped with a spring latch with interior and exterior turn handles
3. Roof hatch shall be equipped with interior and exterior padlock hasps.
4. The latch strike shall be a stamped component bolted to the curb assembly.
5. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1” (25.4mm) diameter red vinyl grip handle to

permit easy release for closing.
6. Compression spring tubes shall be an anti-corrosive composite material and all other hardware shall be zinc plated and chromate sealed. Springs shall have an electrocoated acrylic finish for corrosion resistance. [For installation in highly corrosive environments or when prolonged exposure to hot water or steam is anticipated, specify Type 316 stainless steel hardware].
7. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

I. Finishes: Factory finish shall be mill finish aluminum.

III. PART THREE - EXECUTION

3.01 INSPECTION

A. Verify that roof hatch installation will not disrupt other trades. Verify that the substrate is dry, clean, and free of foreign matter. Report and correct defects prior to any installation.

3.02 INSTALLATION

A. Submit product design drawings for review and approval to the architect or specifier before fabrication.

B. The installer shall check as-built conditions and verify the manufacturer’s roof hatch details for accuracy to fit the application prior to fabrication. The installer shall comply with the roof hatch Manufacturer's installation instructions.

C. The installer shall furnish mechanical fasteners consistent with the roof requirements.

END OF SECTION 07720

SECTION 07730 - WIND LOAD RATED ROOF CURBS AND RESTRAINT BRACKETS

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. Design, construct, furnish and install roof curbs, brackets and related items to meet governing building codes, as demonstrated by comprehensive analysis that the load resisting capabilities meet or exceed requirements.

1.3 QUALITY ASSURANCE

A. Meet requirements of the International Building Code, ASCE Std 7, TDI, and other applicable codes for the location. This specification shall be a minimum requirement for wind load design consideration, and is not intended as a substitute for legislated, more stringent, national, state or local requirements.

B. Wind-induced forces shall be determined by governing code requirements. See attached Design Wind Pressure Requirements Memo by Structural Engineer.
   1. Wind-generated force shall be reduced into an equivalent statically applied force.
   2. The statically applied force shall act in horizontal and vertical directions at the center of gravity of the rooftop mounted equipment, resulting in torsion, flexure, tension and shear forces that the wind restraint brackets shall be shown to be able to resist.

C. Install products in strict accordance with applicable codes and manufacturers' standards. Whenever a conflict occurs between the manufacturers or construction standards, the most stringent shall apply.

1.4 SUBMITTALS

A. Manufacturer's statement showing that the curbs and wind load restraint brackets meet the applicable code requirements, signed and sealed by a licensed professional engineer (PE). Provide the following:
   1. Wind restraint calculations for all connections of rooftop-mounted equipment to roof curb, and roof curb to the structure.
   2. Drawings showing curbs, wind restraint bracket dimensions, make and model compatible with rooftop unit, including type of connection hardware required.

PART 2 - PRODUCTS

2.1 ROOF CURBS AND RESTRAINTS

A. Approved manufacturers of roof curbs and wind load restraint brackets:
   1. Curbs Plus, Complete Curbs, Thybar Corporation.
   2. Others shall obtain a written pre-approval one week prior to bidding.

B. Products shall be made of a material (Prime G-90 galvanized steel or galvalume) compatible with roof curb and the rooftop unit base-rail material. Dissimilar metals shall not to be used.
   1. Fully welded mitered corners for wind load consideration
   2. Base flange attachments for securing curb to structure.
   3. Factory installed wood nailer for attachment of roofing material.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's written instructions.

B. Attach rooftop equipment to roof curbs with wind load restraint brackets of size, type and quantity as determined by equipment manufacturer.

C. Attach roof curb to the building structure at the curb base flanges. Base flange attachment options include anchor bolts, welded connections and mechanical fasteners.

D. Do not install wind load restraint brackets in a manner that will result in inadequate maintenance access, base-rail damage, or roof curb reduced weight carrying capacity.

E. Prior to performing installation of restraint brackets, notify Engineer of any conflicts with other trades or equipment that may result in undesirable contact due to inadequate space or other unforeseen conditions. Notify Engineer of any discrepancies between the specifications and field conditions or changes required due to specific equipment selection prior to installation.

F. Corrective work necessitated by discrepancies or conflicts after installation shall be at the contractor's expense.

3.2 INSPECTION

A. On completion of installation, inspect the completed system and report in writing any installation error or other faults in the system that could affect the wind load resistant capabilities of the roof top assembly.

B. The Contractor shall submit a report to the project designer, including the above report with consequent steps taken to properly complete the wind load restraint installation.

END OF SECTION

SECTION 07900 - JOINT SEALERS

PART 1 - GENERAL

RELATED DOCUMENTS:
Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:
Extent of each form and type of joint sealer is indicated on drawings and by provisions of this section.

Refer to Division 8 sections glazing requirements; not work of this section.

Refer to sections of Division 15 and 16 for joint sealers in mechanical and electrical work; not work of this section.

General Performance: Except as otherwise indicated, joint sealers are required to establish and maintain airtight and waterproof continuous seals on a permanent basis, within recognized limitations of wear and as indicated for each application. Failures of installed sealers to comply with this requirement will be recognized as failures of materials and workmanship.

SUBMITTALS:
Product Data: Submit manufacturer's product specifications, handling/installation/curing instructions, and performance tested data sheets for each elastomeric product required.

JOB CONDITIONS:
Weather Conditions: Do not proceed with installation of liquid sealants under unfavorable weather conditions. Install elastomeric sealants when temperature is in lower third of temperature range recommended by manufacturer for installation.

PART 2 - PRODUCTS

MATERIALS:
General Sealer Requirements: Provide colors indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors. Select materials for compatibility with joint surfaces and other indicated exposures, and except as otherwise indicated select modules of elasticity and hardness or grade recommended by manufacturer for each application indicated. Where exposed to foot traffic, select non-tracking materials of sufficient strength and hardness to withstand stiletto heel traffic without damage or deterioration of sealer system.

Sealant: (with expansion and compression capability of plus or minus 50%).
Silpruf Silicone weatherproofing sealant: General Electric
790 Building Sealant: Down Corning

Caulking:
NP -2 Sonneborn. Polyurethane
Install at all locations where notes as "caulk" or required to provide a neat joint.

Expansion Joint Sealer:
ACMA Seal: ACME Highway Products Corp., Buffalo, N.Y. 14207

System: Series “J”, Style No. 2-602, 1-3/4" wide x 2" high.
Install with manufacturer’s ACMA Lubricant Adhesive.

Wall Penetration Sealant:
FireBarrier Silicone Sealant - 3M™ Fire Barrier Silicone Sealant 2000+ or approve equal.
Fire Barrier Foam Sealant - 3M™ Fire Barrier Rated Foam FIP 1-Step or approve equal.

Foam Joint Filters:
Expanded Polyethylene Joint Filler (ExPe -JF): Provide flexible, compressible, closed - cell, polyethylene of not less than 10 psi compression deflection (25%) except provide higher compression deflection strength as may be necessary to withstand installation forces and provide proper support for sealants; surface water absorption of not more than 0.1 lbs. per sq. ft.

MISCELLANEOUS MATERIALS:
Sealant backer Rod (S -Br): Provide compressible rod stock of polyethylene foam, polyurethane foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable non-absorptive material as recommended by sealant manufacturer for backup of an compatibility with sealant. Where used with hot -applied sealant, provide heat -resistant type which will not be deteriorated by sealant application temperature as indicated.

PART 3 - EXECUTION

INSPECTION:
Installer must examine substrates, (joint surfaces) and conditions under which joint sealer work is to be performed, and must notify Contractor in writing of unsatisfactory conditions. Do not proceed with joint sealer work until unsatisfactory conditions have been corrected in a manner acceptable to installer.

JOINT PREPARATION:
Clean joint surfaces immediately before installation of gaskets, sealant or caulking compounds. Remove dirt, insecure coatings, moisture and other substances which could interfere with seal of gasket or bond of sealant or caulking compound. Etch concrete and masonry join surfaces as recommended by sealant manufacturer. Roughen vitreous and glazed joint surfaces as recommended by sealant manufacturer.

Prime or seal joint surfaces where indicated, and where recommended by sealant manufacturer. Confine primer/sealer to areas of sealant bond; do not allow spillage or migration onto adjoining surfaces.
INSTALLATION:
Install at exterior doors, glass frames (both interior and exterior of frames), exterior louvers, windows, exterior joints in walls and other locations where indicated or required to provide weather tight joints. Indicated for floor or wall assembly in which penetration occurs.

Install in accordance with manufacturer's recommendations.
Produce beads of proper width and depth.
Tool as recommended by manufacturer.
Remove surplus materials.

Study drawings and furnish and install proper materials at each point where called for on the drawings plus all other points essential to continued integrity of the watertight barrier.

CURE AND PROTECTION

Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability. Advise the Contractor of procedures required for cure and protection of joint sealer during construction period, so that they will be without deterioration or damage (other than normal wear and weathering) at time of substantial completion. Cure and protect sealants in a manner which will minimize increases in modules of elasticity and other accelerated aging effects. Replace or restore sealant which are damaged or deteriorated during construction period.

END OF SECTION 07900

SECTION 08100 - STEEL DOORS AND FRAMES

PART 1 - GENERAL

RELATED DOCUMENTS:
Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:
Extent of standard steel doors and frames is indicated and scheduled on drawings.

Custom hollow metal work is specified in other Division 8 sections.
Builder's hardware is specified elsewhere in Division 8. Galvanized

QUALITY ASSURANCE:
Provide doors and frames complying with Steel Door Institute "Recommended Specifications: Standard Steel Doors and Frames" (SDI 100) and as herein specified.

Provide Hurricane Resistant Steel Doors and Frames Equal to: Steel Craft Mfg. Co. H-Series Doors at all exterior door openings.

Manufacturer: Provide standard steel doors and frames by a single firm specializing in production of this type of work. Acceptable Manufacturer's:

Texas Door Products
Ceco Corp.
Republic Builders Prod. Corp.
Tex Steel Corp.
Pearland Industries
Deansteel

Provide galvanized and insulated doors and frames at exterior conditions only.

SUBMITTALS:

Product Data: Submit manufacturer's specifications for fabrication and installation, including data substantiating that products comply with requirements.

Shop Drawings: Submit for fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

Provide schedule of doors and frames using same reference numbers for details and openings as those on contract drawings.

Wind Pressures Requirements: Submit documentation stating the door and frame system has been designed to meet project wind pressure as defined by the structural engineer and comply with Texas Windstorm Guidelines.

Label Construction Certification: Submit manufacturer's certification for oversize fire rated doors and frames that each assembly has been constructed with materials and

methods equivalent to requirements for labeled construction.

DELIVERY, STORAGE AND HANDLING:
Deliver hollow metal work in cartons or crated to provide protection during transit and job storage. Provide additional sealed plastic wrapping for factory finished doors.

Inspect hollow metal work upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to Architect; otherwise, remove and replace damaged items as directed.

Store doors and frames at building site under cover. Place units on wood sills at least 4" high, or otherwise store on floors in manner that will prevent rust and damage. Avoid use of non vented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide 1/4" spaces between stacked doors to promote air circulation.

PART 2 - PRODUCTS

MATERIALS:

Hot Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 569 and ASTM A 568.

Cold Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A 366 and ASTM A 568.

Supports and Anchors: Fabricate of not less than 18 gage galvanized sheet steel.

Inserts, Bolts and Fasteners: Manufacturer's standard units, except hot dip galvanized items to be built into exterior walls, complying with ASTM A 153, Class C or D as applicable.

Shop Applied Paint:

Primer: Rust inhibitive enamel or paint, either air drying or baking, suitable as a base for specified finish paints.

FABRICATION, GENERAL:
Fabricate steel door and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at project site.

Fabricate exposed faces of doors and panels, including stiles and rails of non-flush units, from only cold rolled steel.

Fabricate frames, concealed stiffeners, reinforcement, edge channels, louvers and moldings from either cold rolled or hot rolled steel (at fabricator's option).

Finish Hardware Preparation:

Prepare doors and frames to receive mortised and concealed finish hardware in accordance with final Finish Hardware Schedule and template provided by hardware

supplier. Comply with applicable requirements of ANSI A 115 series specifications for door and frame preparation for hardware. Exterior doors shall be fabricated and assembled using frame, hinge, and locking hardware as indicated on third party test report.

Reinforce doors and frames to receive surface applied hardware. Drilling and tapping for surface applied finish hardware may be done at project site.

Locate finish hardware as indicated on final shop drawings or, if not shown, in accordance with "Recommended Locations for Builder's Hardware," published by Door and Hardware Institute.

Shop Painting:
Clean, treat, and paint exposed surfaces of steel door and frame units, including galvanized surfaces.

Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.

Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint.

STANDARD STEEL DOORS:
Provide metal doors of types and styles indicated on drawings or schedules.

	1 3/4" doors
Stiles	16 ga.
Panels	16 ga.
Hinge Tap Plate	9 ga.
Hinges	1 1/2 pair 4 1/2 x 4 1/2 full mortise template typ
Lock reinforcement	3/32" steel
Lock Set	See Hardware Schedule
Door Closer Reinforcement	9 ga.
Insulated	PolyurethaneR-5

Door Louvers:
Provide sight proof stationary louvers for interior doors where indicated, constructed of inverted V shaped or Y shaped blades formed of 24 gage cold rolled steel set into 20 gage steel frame.

For fire rated openings, provide tightly fitted, spring loaded, automatic closing louvers with operable blades, equipped with fusible links, arranged so that metal overlaps metal at every joint.

STANDARD STEEL FRAMES:
Provide metal frames for doors, transoms, sidelights, borrowed lights, and other openings, of types and styles as shown on drawings and schedules. Conceal fastenings, unless otherwise indicated.

Frames shall be 16 gauge
Fabricate frames with metered corners, knocked down not acceptable.

Door Silencers: Except on weatherstripped frames, drill stops to receive 2 silencers on

strike jambs of single swing frames and 3 silencers on heads of double swing frames.

Glazing Stops: 16 ga. steel channel with pre drilled holes for flat heads of double sink screws.

Plaster Guards: Provide 26 gauge steel plaster guards or mortar boxes, welded to frame, at back of finish hardware cutouts where mortar or other materials might obstruct hardware operation.

Fire Resistant Frames: Provide 1-hr rated doors in partitions shown on plans and as scheduled.

PART 3 - EXECUTION

INSPECTION:
Installer must examine substrate and conditions under which steel doors and frames are to be installed and must notify Contractor in writing of any conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

INSTALLATION:

General: Install standard steel doors, frames, and accessories in accordance with final shop drawings, manufacturer's data, and as herein specified.

Placing frames:

Comply with provisions of SDI 105 "Recommended Erection Instructions for Steel Frames", unless otherwise indicated.

Except for frames located at in place concrete or masonry and at drywall installations, place frames prior to construction at enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.

In masonry construction, locate 3 wall anchors per jamb at hinge and strike levels. Building in of anchors and grouting of frames is specified in Division 4.

At in-place concrete or masonry construction, set frames and secure to adjacent construction with machine screws and masonry anchorage devices.

Install fire rate frames in accordance with NFPA STD. No. 80.

In metal stud partitions, install at least 3 wall anchors per jamb at hinge and strike levels. In open steel stud partitions, place studs in wall anchor notches and wire tie. In closed steel stud partitions, attach wall anchors to studs with tapping screws.

Door Installation:

Fit hollow metal doors accurately in frames, within clearances specified in SDI 100.

Place fire rated doors with clearances as specified in NFPA Standard No. 80.

ADJUST AND CLEAN:

Prime Coat Touch up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch up of compatible air drying primer.

Protection Removal: Immediately prior to final inspection, remove protective plastic wrappings from pre-finished doors.

Final Adjustments: Check and readjust operating finish hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.

END OF SECTION 08100

SECTION 08210 - WOOD DOORS

PART 1 - GENERAL

RELATED DOCUMENTS
Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to of this section.

DESCRIPTION OF WORK:

Extent and location of each type of wood door is shown on drawings and in schedules.

Types of doors required include the following:

Prefinished standard and fire rated type wood doors with flush faces.

Louvers for wood doors, including furnishing and installation, are specified under this section. Louvers are to be furnished by mechanical contractor.

QUALITY ASSURANCE:

NWMA Quality Marking: Mark each wood door with NWMA Wood Flush Door Certification Hallmark certifying compliance with applicable requirements of ANSI/NWMA I.S. 1 Series. For manufacturers not participating in NWMA Hallmark Program, a certification of compliance may be substituted for marking of individual doors.

REFERENCES:

Comply with the applicable requirements of the following standards unless otherwise indicated.

ANSI/AWMA I.S. 1, “Industry Standard for Wood Flush Doors" published by National Woodwork Manufacturers Associates (NWMA).

AWI Quality Standard: Section 1300 of "Architectural Woodwork Quality Standard" published by the Architectural Woodwork Manufacturers (AWI). Designations for grade and core construction under types of doors refer to this standard.

SUBMITTALS:

Product Data: Submit door manufacturer's product data, specifications and installation instructions for each type of wood door.

Include certifications as may be required to show compliance with specifications.

Shop Drawings: Submit shop drawings indicating location and size of each door, elevation of each kind of door, details of construction, location and extent of hardware blocking, fire ratings, requirements for factory finishing and other pertinent data.

Samples: Submit samples for the following:

Factory Finished Doors: Submit 8" x 11" samples showing fully completed factory finish on same veneer and edge construction that will be used on factory-finished doors. Submit full range of samples from which selection can be made. Tinting stain may be required at architect's option in order to match finish on existing doors to remain.

Specific Product Warranty: Submit written agreement in door manufacturer's standard form signed by Manufacturer, Installer and Contractor, agreeing to repair or replace defective doors which have warped (bow, cup or twist) or which show photographing of construction below in face veneers, or do not conform to tolerance limitations of NWMA.

1. All work in this Section shall be warranted by a **FULL DOOR WARRANTY** (from the date of installation) against defect in materials and workmanship, including the following:
    a. Delamination in any degree.
    b. Warp or twist of ¼" or more in any 3'6" x 7'0" section of a door.
    c. Telegraphing of any part of core assembly through face to cause surface variation of 1/100" or more in a 3" span.
    d. Any defect which may, in any way, impair or affect performance of the door for the purpose which it is intended. Replacement under this warranty shall include hanging, installation of hardware, and finishing.
2. Periods of warranty after date or installation:
    a. Interior solid core and mineral core Life of original installation.
3. Doors must be stored, finished, hung and maintained per manufacturers recommendations set forth in their Full Door Warranty.

PRODUCT DELIVERY, STORAGE, AND HANDLING:

Protect wood doors during transit, storage and handling to prevent damage, soiling and deterioration. Comply with "On Site Care" recommendations of NWMA pamphlet "Care and Finishing of Wood Doors" and with manufacturer's instructions and otherwise indicated.

PART 2 - PRODUCTS

BASIS OF DESIGN: Graham Assa Abloy – Copper 250

ACCEPTABLE MANUFACTURERS:

VT Industries
Graham Assa Abloy
Oshkosh Door Company
Haley Architectural Doors

All other door manufacturers must receive prior approval before allowed as substitute.

MATERIALS AND COMPONENTS:

General: Provide wood doors complying with applicable requirements of NWMA I.S. 1 for kinds and types of doors indicated and as specified.

Face Panels: Manufacturer's standard 5 ply panels hot pressed, unless otherwise indicated.

Exposed Surfaces: Provide same exposed surface material on both faces of each door, unless otherwise indicated.

Exposed edges shall be hardwood and compliment face veneer species.

GENERAL FABRICATION REQUIREMENTS:

Transom and Side Panels: Wherever transom panels or side panels of wood are shown in same framing systems as wood doors, provide panels which match quality and appearance of associated wood doors, unless otherwise indicated. Fabricate matching panels with same construction, exposed surfaces and finish as specified for associated doors.

INTERIOR FLUSH WOOD DOORS:

Faces:	Red oak, plain sliced or rotary cut, 2 end matched panels.
Grade:	A.
Core Construction:	SLC (structural composite lumber core).
Edges:	Hardwood

Particle Core door will NOT BE ACCEPTED.
Vision Lite Frames shall meet 20 minutes rating.

Provide 60 minute label doors in partitions shown on plans and as scheduled.

FACTORY FINISH:

1. Comply with referenced WDMA Section G-15, “Factory Finishing.”.
2. Pre-finish wood doors at factory.
3. Transparent Finish: Match finish indicated in WDMA Section G-17: WDMA System #6.

PRE-FITTING AND PREPARATION FOR HARDWARE:

Comply with tolerance requirements of NWMA for pre-fitting. Machine the wood doors where hardware requires cutting of doors. Comply with final hardware schedules and door frame shop drawings and with hardware templates and other essential information required to ensure proper fit of doors and hardware.

Take accurate field measurements of hardware mortises in metal frames to verify dimensions and alignment before proceeding with machining in factory.

PART 3 - EXECUTION

INSPECTION:

Installer must examine door frames, and verify that frames are correct type and have been installed as required for proper hanging of corresponding doors and notify Contractor in writing of conditions detrimental to proper and timely installation of wood doors. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

INSTALLATION:
Condition doors to the average humidity of the installation areas prior to hanging.

Hardware: For installation see Division 8 "Builders Hardware" section of these specifications.

Manufacturer's Instructions: Install wood doors in accordance with manufacturer's instructions and as shown.

Job Fit Doors: Align doors to frame for proper fit and uniform clearance at each edge and machine for hardware. Seal cut surfaces after fitting and machining.

Clearance: For non fire doors provide clearances of 1/8" at jambs and heads; 1/8” at meeting stiles for pairs of doors; and 1/2" from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4" clearance from bottom of door to top of threshold.

Job Site Finished Doors: See painting sections in Division 9 of these specifications for finishing requirements for finishing wood doors.

ADJUST AND CLEAN:

Operation: Re-hang or replace doors which do not swing or operate freely, as directed by Architect.

Finished Doors: Refinish or replace doors damaged during installation, as directed by Architect.

Protection and Completed Work: Advise Contractor of proper procedures required for protection of installed wood doors from damage or deterioration until acceptance of work.

END OF SECTION 08210

SECTION 08410 - ALUMINUM ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

RELATED DOCUMENTS:
Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:
Extent of aluminum entrances and storefronts is shown on drawings and schedules.

Types of aluminum entrances and storefronts required include the following:

Aluminum entrance frames.
Aluminum sash and sidelight.
Miscellaneous items required for complete installation.
Hardware for aluminum entrances.

Glazing: Refer to "Glass and Glazing" section of Division 8 for glazing requirements for aluminum entrances and storefronts, including doors specified herein to be factory pre-glazed.

Mortise cylinders are specified in Division 8 hardware section.

QUALITY ASSURANCE:
Drawings are based on one manufacturer's standard aluminum entrance and storefront system. Another standard system of a similar and equivalent nature will be acceptable when differences do not materially detract from design concept or intended performances, as judged solely by Architect.

Field Measurement: Wherever possible, take field measurements prior to preparation of shop drawings and fabrication, to ensure proper fitting of work. However, proceed with fabrication and coordinate installation tolerances as necessary when field measurements might delay work.

REFERENCES:
Standards: Comply with applicable provisions of "Metal Curtain Wall, Window, Storefront, and Entrance Guide Specifications Manual" by AAMA.

SUBMITTALS:
Product Data: Submit manufacturer's specifications, standard details, and installation recommendations for components of aluminum entrances and storefronts required for project, including data that products have been tested and comply with performance requirements.

Shop Drawings: Submit shop drawings for fabrication and installation of aluminum entrances and storefronts, including elevations, detail sections of typical composite members, anchorages, reinforcement, expansion provisions, and glazing. Provide shop drawings with approved anchoring for compliance with ASTM testing procedure.

Wind Pressure and Impact Resistance Requirements: Submit documentation stating the storefront system has been designed to meet a wind pressure defined by the structural engineer and Texas Windstorm Guidelines, where applicable. Submit product

evaluation reports or independent third party testing stating the storefront system has been tested to meet the project wind pressure and impact resistance requirements for large missile impact.

PART 2 PRODUCTS

MATERIALS AND ACCESSORIES:
Basis of Design: Oldcastle Building Envelope FG-5100 StormMax Aluminum Storefronts.
Basis of Design: Oldcastle Building Envelope MSD-375 StromMax Aluminum Outswing Glass Door with Transom System

Acceptable Manufacturers: (Must meet requirements of ASTM 1886, where applicable)
Kawneer Company, Inc.
Oldcastle Building Envelope

Aluminum Members with Rugged Frame: Alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish; ASTM B 221 for extrusions, ASTM B 209 for sheet/plate.

Thickness: Major portions of sections shall be .125 inch minimum thickness. Moldings, trim and glass stops shall be .050 minimum thickness.

Fasteners: Aluminum, non-magnetic stainless steel, or other materials warranted by manufacturer to be non-corrosive and compatible with aluminum components.

Do not use exposed fasteners except where unavoidable for application of hardware. Match finish of adjoining metal.

Provide Phillips flat head machine screws for exposed fasteners.

Brackets and Reinforcements: Manufacturer's high strength aluminum units where feasible; otherwise, nonmagnetic stainless steel or hot dip galvanized steel complying with ASTM A 386.

Concrete/Masonry Inserts: Cast iron, malleable iron, or hot dip galvanized steel complying with ASTM A 386.

Compression Weather-stripping: Manufacturer's standard replaceable stripping of either molded neoprene gaskets complying with ASTM D 2000 or molded PVC gaskets complying with ASTM D 2287.

Glass and Glazing Materials: Provide glass and glazing materials which comply with requirements of "Glass and Glazing" section of these specifications. Exterior glazing shall be tested per ASTM E1300 and meet project wind pressure and impact resistance requirements for large missile impact.

Aluminum entrance door and window assemblies shall be tested per ASTM E 330 for standard uniform wind pressure. Tested assemblies shall be rated to meet or exceed project wind pressures.

Aluminum entrance door and window assemblies shall be tested per ASTM E 1886 and meet the performance requirements of ASTM E1996 for wind borne debris impact by large missiles.

HARDWARE:
General: Refer to hardware section of Division 8 for requirements for hardware items other than those indicated herein to be provided by manufacturer of aluminum entrances.

Provide door manufacturer's severe weather certified hardware units as indicated, scheduled, or required for operation of each door complying with testing reports or product evaluation report. Provide ICC Compliant Report.

Required Hardware and Accessories (each door leaf):
Continuous Piano Hinge
Surface Mounted Vertical Rod Panic Hardware
Door Pulls
Astragal
Closers
Weather-stripping
Accessible Threshold

Refer to Section 08700 - Builders Hardware for additional requirements. Refer to Section 08700 for requirements for hardware items other than those indicated herein to be provided by manufacture of aluminum entrances.

FABRICATION:

General:
Sizes and Profiles: Required sizes for door and frame units, including profile requirements, are indicated on drawings. Any variable dimensions are indicated, together with maximum and minimum dimensions required to achieve design requirements and coordination with other work.

Details shown are based upon standard details by manufacturer indicated. Similar details by other manufacturers listed will be acceptable, provided they comply with other requirements including profile limitations.

Prefabrication: To greatest extent possible, complete fabrication, assembly, finishing, hardware application, and other work before shipment to project site. Disassemble components only as necessary for shipment and installation.

Do not drill and tap for surface mounted hardware items until time of installation at project site.

Sequence: Complete cutting, fitting, forming, drilling, and grinding of metal work prior to cleaning, finishing, surface treatment, and application of finishes. Remove arrises from cut edges and ease edges and corners to radius of approximately 1/64".

Welding: Comply with AWS recommendations to avoid discoloration; grind exposed welds smooth and restore mechanical finish.

Reinforcing: Install reinforcing as necessary for performance requirements; separate dissimilar metals with bituminous paint or other separator which will prevent corrosion.

Continuity: Maintain accurate relation of planes and angles, with hairline fit of contacting

members.

Fasteners: Conceal fasteners wherever possible.

Weather-stripping: For exterior doors, provide compression weather-stripping against fixed stops; at other edges, provide sliding weather-stripping retained in adjustable strip mortised into door edge.

Provide heavy duty, hollow, compression weather-stripping in bottom door rail, adjustable for contact with threshold.

Storefront Framing System (AL SF): Storefront and assembly shall be designed to comply with ASTM E 1886, BCCO PA 201,PA 202 AND PA 203.

General: Inside outside matched resilient flush glazed system, fabricated for stick type erection procedure with provision for glass replacement.

Frames: Frames, mullions and transom bars shall be constructed of aluminum extrusions, size 2-1/2" x 5" x 1/8" minimum wall thickness unless otherwise indicated on the drawings. Hurricane Resistant Storefront wall thickness must comply with TDI Product Evaluation Report.

End Dam: Provide end dams at each side of sill condition at base or transom panel.

Glazing: Fabricate doors to facilitate replacement of glass or panels, without disassembly of door stiles and rails. Provide snap on extruded aluminum glazing stops, with exterior stops anchored for non-removal.

FINISHES:

Natural Anodized Aluminum Finish

PART 3 EXECUTION

INSTALLATION:
Comply with manufacturer's instructions and recommendations for installation of aluminum entrances and storefronts.

Set units plumb, level, and true to line, without warp or rack of framing members, doors, or panels. Anchor securely in place, separating aluminum and other corrodible metal surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

Drill and tap frames and doors and apply surface mounted hardware templates, complying with hardware manufacturer's instructions and template requirements. Use concealed fasteners wherever possible.

Set sill members and other members in bed of compound as shown, or with joint fillers or gaskets as shown to provide weather tight construction. Comply with requirements of Division 7 for compounds fillers, and gaskets.

Refer to "Glass and Glazing" section of Division 8 for installation of glass and other panels shown to be glazed into doors and framing, and not pre-glazed by manufacturer.

ADJUST AND CLEAN:
Adjust operating hardware to function properly, without binding, and to provide tight fit at contact points and weather-stripping.

Clean system, inside and out, after erection and installation of glass and sealants. Remove excess glazing and joint sealant, dirt, and other substances from aluminum surfaces. Remove protective coating when completion of construction activities no longer requires its retention.

Institute protective measures and other precautions required to assure that aluminum entrances and storefronts will be without damage or deterioration, other than normal weathering, at time of acceptance.

END OF SECTION 08410

SECTION 08520 - ALUMINUM WINDOWS

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Extent of each type of aluminum window unit is indicated on drawings.

Types of aluminum window units required include the following:

Fixed Aluminum window units

Applications of aluminum windows on project include the following:

Individual units set in conventional wall construction.

Units in continuous runs, with mullions

Glazing: Refer to "glass and glazing" section of Division 8 for glazing all window units, including those specified to be factory pre-glazed.

SYSTEM DESCRIPTION:

Performance and Testing:

General: Except as otherwise indicated, comply with air infiltration tests, water resistance tests, uniform load deflection tests, and uniform load structural tests specified in ANSI/AAMA 302.9 for type and classification of window units required in each case.

Testing: Contractor to perform water tests through a recognized testing laboratory or agency and provide certified test results. Minimum of (6) six windows will be tested.

QUALITY ASSURANCE: Design Criteria: Drawings indicate sizes, profiles and dimensional requirements of aluminum windows. Window units having minor deviations from dimensions and profiles indicated on drawings may be accepted, provided such deviations do not materially detract from design concept or intended performances and subject to approval of the Architect.

Design Criteria: Drawings are based on specific type and model aluminum window by a single manufacturer. Equivalent type windows by other listed manufacturers may be accepted, provided deviations in dimensions and profile are minor and do not materially detract from design concept or intended performances, as judged solely by the Architect.

REFERENCES:

Standards: Except as otherwise indicated, requirements for aluminum windows, terminology and standards of performance, and fabrication workmanship are those specified and recommended in ANSI/AAMA 302.9 and applicable general

recommendations published by AAMA and AA.

SUBMITTALS:

Product Data: Submit manufacturer's technical product data, specifications, recommendations, and standard details for aluminum window units, including certified test laboratory reports as necessary to show compliance with requirements.

Shop Drawings: Submit shop drawings, including wall elevations at l/4” scale, typical unit elevations at 3/4" scale, and full size detail sections of every typical composite member. Show anchors, hardware, operators, and other components not included in manufacturer's standard data. Include glazing details.

Wind Pressures Requirements: Submit documentation stating the door and frame system has been designed to meet a wind pressure defined by the structural engineer and Texas Windstorm Guidelines, where applicable.

Certification: Where manufacturer's standard window units comply with requirements and have been tested in accordance with specified tests, provide certification by manufacturer showing compliance with ASTM E 1886, BCCO PA 201,PA 202 AND PA 203, where applicable.

PART 2 PRODUCTS

ACCEPTABLE MANUFACTURERS:

Old Castle Building Envelope
Kawneer

Manufacturer: Subject to compliance with requirements, provide window units by one of the following for each type of window unit required:

Basis of Design: Oldcastle Building Envelope FG-5100 StormMax Aluminum Storefronts.

MATERIALS:

Window frames and sash members shall be commercial quality 6063 T5 extruded aluminum of not less than .062" wall thickness. Sill members shall be not less than .078" thickness.

Fasteners: Aluminum, non magnetic stainless steel, or other materials warranted by manufacturer to be non-corrosive and compatible with aluminum window members, trim, hardware, anchors and other components of window units.

Reinforcement: Where fasteners screw anchor into aluminum less than 0.l25" thick, reinforce interior with aluminum or non magnetic stainless steel to receive screw threads, or provide standard non corrosive pressed in splined grommet nuts.

Do not use exposed fasteners except where unavoidable for application of hardware. Match finish of adjoining metal.

Provide Phillips flat head machine screws for exposed fasteners.

Anchors, Clips and Window Accessories: Depending on strength and corrosion inhibiting requirements, fabricate units of aluminum, non magnetic stainless steel, or hot dip zinc coated steel or iron complying with ASTM A 386.

Compression Glazing Strips and Weatherstripping: At manufacturer's option, provide molded neoprene gaskets complying with ASTM D 2000 Designation 2BC4l5 to 3BC620, molded PVC gaskets complying with ASTM D 2287, or molded expanded neoprene gaskets complying with ASTM C 509, Grade 4.

Sliding Weatherstripping: Provide woven pile weatherstripping of wool, polypropylene or nylon pile and resin impregnated backing fabric, and aluminum backing strip; comply with AAMA 701.

Friction shoes: Nylon or other non-abrasive, non-metallic, non-staining, non corrosive durable material.

All muntins, horizontal sash members, and meeting rails shall be tubular sections.

The perimeter of the vent (s) shall be completely weatherstripped with woven pile and vinyl.

Each unit shall be equipped with white bronze positive cam lock and keeper.

Spiral balances shall be adjustable and replaceable.

All anchors shall be manufacturer’s standard anchors, unless otherwise detailed and specified.

For double hung only: The lower sash shall have a continuous integral lift rail in sash sill and the upper sash shall be equipped with necessary pull handles.

CLASSIFICATION (GRADE):

Commercial Windows (Grade A3): Except as otherwise indicated, provide window units complying with requirements of AAMA Classification A2, for "Commercial" type buildings.

WINDOW TYPES (OPERATION):

General: Following paragraphs defined operating arrangements for types of sash (ventilators) required in window units and specify minimum provisions for each type. Drawings indicate which panels of each window unit are operable sash and which are fixed. Where 2 or more types of operating sash are included in same window unit, operation of each is indicated, and unit is considered a "Combination Aluminum Window".

Windows of the types and sizes shown on the plans or as called for in this specification shall be manufactured by one of the listed acceptable manufacturers to conform with ASTM E 1886, BCCO PA 201,PA 202 AND PA 203. Window units shall be furnished with necessary anchors and clips to provide a complete installation.

FABRICATION AND ACCESSORIES:

General: Provide manufacturer's standard fabrication and accessories which comply with indicated standards and are re-glazed without dismantling of sash framing, except to extent more specific or more stringent requirements are indicated. Include complete system for assembly of components and anchorage of window units, and prepare sash for glazing except where pre-glazing at factory is indicated.

Sizes and Profiles: Required sizes of window units and profile requirements are shown on drawings. Variable dimensions (if any) are indicated along with maximum and minimum dimensions as required to achieve design requirements and coordination with other work.

> Details on drawings are based upon standard details by one or more manufacturers. It is intended that similar details by other manufacturers will be acceptable, provided they comply with size requirements, minimum/maximum profile requirements, and performance standards as indicated or specified.

Coordination of Fabrication: Where possible, check actual window openings in construction work by accurate field measurement before fabrication, and show recorded measurements on final shop drawings. However, coordinate fabrication schedule with construction progress as directed by Contractor to avoid delay of work. Where necessary, proceed with fabrication without field measurements, and coordinate installation tolerances to ensure proper fit of window units.

Pre-glazed Fabrication: Pre-glazed window units alsynite/structoglass where possible and practical for applications indicated. Comply with requirements of section "Glass and Glazing" in addition to requirements of ANSI/AAMA 302.9.

Provide water shed members above side hinged ventilators and at similar lines of natural water penetration.

Provide means of drainage for water and condensation which may accumulate in members of window units. Provide manufacturer’s pre-manufactured sill flashing. For Vista Wall window unit sill flashing shall be equal to part no. FG-2169. Sill flashing shall match finish of aluminum window system.
Weather-stripping: Provide compression type weather-stripping at perimeter of each operating sash, except provide sliding weather-stripping at all locations where sash rails slide horizontally or vertically along frame of units.

Provide sub-frames with anchors for window units where shown, of profile and dimensions indicated but not less than 0.062" thickness extruded aluminum; with mitered or coped corners, welded and dressed smooth or with concealed mechanical joint fasteners; finish to match window units.

Provide mullions and cover plates as shown, matching window units, and complete with anchors for support and installation. Allow for erection tolerances and provide for movements of window units due to thermal expansion and building deflections.

Provide inserts to close off all open extrusions to allow for proper flashing installation.

ALUMINUM WINDOW FINISHES:

Clear Anodized

PART 3 - EXECUTION

INSTALLATION:
Comply with manufacturer’s specifications and recommendations for installation of window units, hardware, operators, and other components of work.

Set units plumb, level, and true to line, without warp or rack of frames or sash. Anchor securely in place. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action.

Set sill members and other members in bed of compound as shown, or with joint fillers or gaskets as shown, to provide weather tight construction. Refer to Division 7 sealant sections for compounds, fillers and gaskets to be installed with window units. Coordinate installation with wall flashing and other components of work.

ADJUST AND CLEAN:

Adjust operating sash and hardware to provide tight fit at contact points and at weatherstripping, and to ensure smooth operation and weather tight closure.

Clean aluminum surfaces promptly after installation of windows, exercising care to avoid damage to protective coatings and finishes. Remove excess glazing and sealant compounds, dirt and clean aluminum surfaces promptly after installation of windows, exercising care to avoid damage to protective coatings and finishes. Remove excess glazing and sealant compounds, dirt and other substances. Lubricate hardware and moving parts.

Clean glass of pre-glazed units promptly after installation of windows; comply with requirements of "glass and glazing" section for cleaning and maintenance.

Initiate and maintain protections and other precautions required to ensure that window units will be without damage or deterioration (other than normal weathering) at time of acceptance.

END OF SECTION 08520

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MANUFACTURERS

Butts	Hager	Hagr
Locksets	Schlage Lock Co.	Schl
Exit Device	Von Duprin	Von
Closers	Nortons	Nort
Mullions	Von Duprin	Von
Stops	Hager	Hagr
Silencers	Hager	Hagr
Thresholds	Hager	Hagr
Weatherstripping	Hager	Hagr

Keys & Keying;
All locks, cylinders and deadbolts shall be Master Keyed as required by the Owner to the Existing Grand Master Key System. Provide cylinders to all locksets, exit devices, etc. whether noted or not. Furnish two (2) keys per locking device.

Provide Hold Open feature at closures to classrooms, kitchen and offices,
Provide Cylinder Dogging at all panic hardware, in lieu of hex key.

Schedule A at doors 1,2,3,29 – each door leaf		
cylinder locks	20-757-626	Primus-Schl
floor stop	243F x 626	Hagr
door bottom	(2)-770 SV x 34" x SMS	Hagr
door drip	810S x 76" x SMS	Hagr

Schedule B at doors no. 4,28		
1.5 pair butts	BB1191 x 4.5 x 4.5 x 630 x NRP	Hagr
exit device	99L x F x 626 x 30"	Von
door closer	P1601 BF x 689 x SNB	Nort
weatherstripping	891 x SV x 36" x 2@ 84" x SMS	Hagr
threshold	520 x SV x 36" x SMS	Hagr
door bottom	770 x SV x 36" x SMS	Hagr
door drip	810S x 40" x SMS	Hagr
floor stop	243F x 626	Hagr
kick plates	190S x 12” x 34” x 626	Nort

Schedule C at doors no.5		
3.0 pair butts	BB1191 x 4.5 x 4.5 x 630 x NRP	Hagr
exit device	99L x 626 x 30"	Von
exit device	99L x 626 x 30"	Von
removable mullion	9954-KR	Von
floor stop	(2) 243F x 626	Hagr
door closer	(2) P1601 BF x 689 x SNB	Nort
threshold	520 x SV x 72" x SMS	Hagr
weatherstripping	891 SV x 72" x 2@ 84" x SMS	Hagr
door bottom	(2)-770 SV x 34" x SMS	Hagr
door drip	810S x 76" x SMS	Hagr
astragal	872S x 84" x SMS	Hagr
kick plates	(2)190S x 12” x 34” x 626	Nort

Schedule D at doors no. 6

1.5 pair Butts	BB1191 x 4.5 x 4.5 x 630 x NRP	Hagr
Lockset	ND75PD x SPA x 626	Schl
Wall Stop	236w x 626	Hagr
Door Closer	P1601 BF-H x 689 x SNB	Nort
Silencers	307D	Hagr

Schedule E at doors no. 7

1.5 pair Butts	BB1191 x 4.5 x 4.5 x 652 x 2"ws	Hagr
Lockset	ND80PD x SPA x 626	Schl
Wall Stop	236w x 626	Hagr
Silencers	307D	Hagr

Schedule F at doors no. 8,9

1.5 pair Butts	BB1191 x 4.5 x 4.5 x 652 x 2"ws	Hagr
push/pull plate	(2)HL x 6 x US x 26D	G/J
dead bolt	B663P x 626 x 12	Schl
Wall Stop	236W x 630	Hagr
Door Closer	P1601 BF x 689 x SNB	Nort
Silencers	307 D	Hagr
kick plates	190S x 12” x 34” x 626	Nort

Schedule G at doors no. 10

1.5 pair Butts	BB1191 x 4.5 x 4.5 x 652 x 2"ws	Hagr
Indicator	B571 x 626	Schl
Lockset	ND53PD x SPA x 626	Schl
Wall Stop	236w x 626	Hagr
Silencers	307D	Hagr

Schedule H at doors no. 11

1.5 pair Butts	BB1191 x 4.5 x 4.5 x 652 x 2"ws	Hagr
Indicator	B571 x 626	Schl
Lockset	ND53PD x SPA x 626	Schl
Wall Stop	236w x 626	Hagr
Door Closer	P1601 BF x 689 x SNB	Nort
Silencers	307D	Hagr

Schedule I at doors no. 12

1.5 pair Butts	BB1191 x 4.5 x 4.5 x 652 x 2"ws	Hagr
Lockset	ND80PD x SPA x 626	Schl
Wall Stop	236w x 626	Hagr
Door Closer	P1601 BF x 689 x SNB	Nort
Silencers	307D	Hagr

Schedule J at doors no. 13 Serving Lines

1.5 pair butts	AB7501 x 4.5 x 4.5 x 630 x NRP	Hagr
floor stop/holder	327F x 626	Hagr
door closer	P1601 BF x 689 x SNB	Nort
threshold	520 x SV x 72" x SMS	Hagr
kick plates	190S x 12” x 34” x 626	Nort
Lockset	ND75PD x SPA x 626	Schl

Schedule K at doors no. 14 Serving Lines

3.0 pair butts	AB7501 x 4.5 x 4.5 x 630 x NRP	Hagr
floor stop/holder	(2) 327F x 626	Hagr
door closer	(2) P1601 BF x 689 x SNB	Nort
threshold	520 x SV x 72" x SMS	Hagr
flush bolts	(2) 282Dx 626	Hagr
astragal	872S x 84" x SMS	Hagr
kick plates	(2)190S x 12” x 34” x 626	Nort
Lockset	ND75PD x SPA x 626	Schl

Schedule L at doors no. 15,19

1.5 pair Butts	BB1191 x 4.5 x 4.5 x 652 x 2"ws	Hagr
Lockset	ND53PD x SPA x 626	Schl
Wall Stop	236w x 626	Hagr
Door Closer	P1601 BF x 689 x SNB	Nort
Silencers	307D	Hagr

Schedule M at doors no. 16

1.5 pair Butts	BB1191 x 4.5 x 4.5 x 652 x 2"ws	Hagr
Lockset	ND53PD x SPA x 626	Schl
Wall Stop	236w x 626	Hagr
Silencers	307D	Hagr

Schedule N at doors no. 17

1.5 pair butts	BB1191 x 4.5 x 4.5 x 630 x NRP	Hagr
exit device	99L x F x 626 x 30"	Von
Wall Stop	236W x 630	Hagr
Door Closer	P1601 BF x 689 x SNB	Nort
Silencers	307D	Hagr
kick plates	190S x 12” x 34” x 626	Nort

Schedule O at doors no. 18

1.5 pair Butts	BB1191 x 4.5 x 4.5 x 630 x NRP	Hagr
Electric Strike	4211	Von
Lockset	AD200-CY-70-KP x SPA x 626	Schl
Wall Stop	236w x 626	Hagr
Door Closer	P1601 BF x 689 x SNB	Nort
Silencers	307D	Hagr

Schedule P at doors no. 20, 21

3.0 pair butts	BB1191 x 4.5 x 4.5 x 630 x NRP	Hagr
exit device	99L x 626 x 30"	Von
exit device	99L x 626 x 30"	Von
removable mullion	9954-KR	Von
floor stop/holder	(2) 327F x 626	Hagr
door closer	(2) P1601 BF x 689 x SNB	Nort
astragal	872S x 84" x SMS	Hagr
threshold	520 x SV x 72" x SMS	Hagr
weatherstripping	891 SV x 72" x 2@ 84" x SMS	Hagr
kick plates	(2)190S x 12” x 34” x 626	Nort

Schedule Q at doors no. 22

2.0 pair butts	BB1191 x 4.5 x 4.5 x 630 x NRP	Hagr
exit device	99L x F x 626 x 42"	Von
door closer	P1601 BF x 689 x SNB	Nort
weatherstripping	891 x SV x 48" x 2@ 84" x SMS	Hagr
threshold	520 x SV x 48" x SMS	Hagr
door bottom	770 x SV x 48" x SMS	Hagr
door drip	810S x 52" x SMS	Hagr
floor stop	243F x 626	Hagr
kick plates	190S x 12” x 46” x 626	Nort

Schedule R at doors no. 23

2.0 pair Butts	BB1191 x 4.5 x 4.5 x 652 x 2"ws	Hagr
Lockset	ND80PD x SPA x 626	Schl
Wall Stop	236w x 626	Hagr
Silencers	307D	Hagr
kick plates	190S x 12” x 46” x 626	Nort

Schedule S at doors no. 24

3.0 pair butts	BB1191 x 4.5 x 4.5 x 630 x NRP	Hagr
dead bolt	B663P x 626 x 12	Schl
floor stop	243F x 626	Hagr
door closer	P1601 BF x 689 x SNB	Nort
threshold	520 x SV x 96" x SMS	Hagr
flush bolts	(2) 282Dx 626	Hagr
astragal	872S x 84" x SMS	Hagr
passage set	ND80S x SPA x 626	Schl
kick plates	(2)190S x 12” x 34” x 626	Nort

Schedule T at doors no. 30 – 45 Min 110deg

1.5 pair butts	BB1191 x 4.5 x 4.5 x 630 x NRP	Hagr
Lockset	L9080J LLL(Less Trim) 17A L283-150 No Trim on inside of Door	Schl
door closer	SC81A Rw/PA	Falcon
weatherstripping	891 x SV x 36" x 2@ 84" x SMS	Hagr
threshold	520 x SV x 36" x SMS	Hagr

Toilet Partition Hardware Typical

Bolts	15109-626	Bomm
Contiunous Piano Hinge	FS-910	Assa
Pull	15020-626	Bomm
Slide Bolts	15004-626	Bomm
Stop/ Hook	15030-626	Bomm
Stop Keeper (Out Swing)	1075-626	Bomm
Stop Keeper (In Swing)	1074-626	Bomm

SECTION 08700 - BUILDERS HARDWARE

PART 1 - GENERAL

RELATED DOCUMENTS:
Drawings and general provisions of Contract, including General and Supplementary Conditions and Division - 1 Specification sections, apply to the work of this section.

DESCRIPTION OF WORK:
Definition: "Builders Hardware" includes items known commercially as builders' hardware which are required for swing, sliding and folding doors, except special types of unique and non-matching hardware specified in the same section as the door and door frame. Types of items in this section include (but are not necessarily limited to):

- Hinges
- Pivots
- Lock cylinders and keys
- Lock and latch sets
- Bolts
- Exit devices
- Push/pull units
- Sliding door equipment
- Closures
- Overhead Holders
- Miscellaneous door control devices

QUALITY ASSURANCE:
Manufacturer: Obtain each kind of hardware (latch and lock sets, hinges, closures, etc.) from only one manufacturer, although several may be indicated as offering products complying with requirements.

Supplier: A recognized builders hardware supplier who has been furnishing hardware in the project's vicinity for a period of not less than 2 years, and who is, or has in employment, an experienced hardware consultant who is available, at reasonable times during the course of the work, for consultation about project's hardware requirements, to Owner, Architect and Contractor.

SUBMITTALS:
Product Data: Submit manufacturers' technical information for each item of hardware. Include whatever information may be necessary to show compliance with requirements, and include instructions for installation and for maintenance of operating parts and finish. Transmit copy of applicable data to Installer.

Hardware Schedule: Submit final hardware schedule in the manner and format specified, complying with the actual construction progress schedule requirements. Hardware schedules are intended for coordination of work.
Final Hardware Schedule: Based on builders hardware indicated, organize hardware schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:

- Type, style, function, size and finish of each hardware item.
- Name and manufacturer of each item.
- Fastenings and other pertinent information.
- Location of hardware set cross - referenced to indications on Drawings

both on floor plans and in door and frame schedule.
Explanation of all abbreviations, symbols, codes, etc. contained in schedule.
Mounting locations for hardware.
Door and frame sizes and materials.
Keying information.

Submittal Sequence: Submit schedule at earliest possible data particularly where acceptance of hardware schedule must precede fabrication of other work (e.g., hollow metal frames) which is critical in the project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by builders' hardware, and other information essential to the coordinated review of hardware schedule.

Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.

PRODUCT HANDLING:
Packaging of hardware, on a set by set basis, is the responsibility of the supplier. As materials received by the hardware supplier from the various manufacturers, sort and repackage in containers marked with the hardware set number. Two or more identical sets may be packed in the same container.

Inventory hardware jointly with representatives of the hardware supplier and the hardware installer until each is satisfied that the count is correct.

Provide secure lock-up for hardware delivered to the project, but not yet installed. Control handling installation of hardware items which are not immediately replaceable, so that the completion of the work will not be delayed by hardware losses, both before and after installation.

JOB CONDITIONS:
Coordination: Coordinate hardware with other work. Tag each item or package separately, with identification related to the final hardware schedule, and include basic installation instructions in the package. Furnish hardware items of proper design for use on doors and frames of the thicknesses, profile, swing, security and similar requirements indicated, as necessary for proper installation and function. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation.

Templates: Furnish hardware templates to each fabricator of doors, frames and other work to be factory - prepared for the installation of hardware. Upon request, check the shop drawings of such other work, to confirm that adequate provisions are made for the proper installation of hardware.

PART 2 - PRODUCTS

SCHEDULED HARDWARE:
Requirements for design, grade, function, finish, size and other distinctive qualities of each type of builders hardware is indicated in the Builders Hardware Data Sheet and Hardware Schedule at the end of this section. Products are identified by using hardware designation numbers of the following.

Manufacturer's product designations: One or more manufacturers are listed for each hardware type required. An asterisk (*) after a manufacturer's name indicates whose product designation is used in the Hardware Schedule for purposes of establishing minimum requirements. Provide product designated, or, where more than one manufacturer is listed, the comparable product of one of the other manufacturers which comply with requirements including those specified elsewhere in this section.

MATERIALS AND FABRICATION:

General:
Hand of door: The drawings show the direction of slide, swing or hand of each door leaf. Furnish each item of hardware for proper installation an operation of the door movement as shown.

Base Metals: Produce hardware units of the basic metal and forming method indicated, using the manufacturer's standard metal alloy, composition, temper and hardness, but in no case of lesser (commercially recognized) quality than specified for the applicable hardware units by FS FF-H-106, FS FF-g-111, FS FF-E-116 and FS FF-H-121. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.

Fasteners: Manufacture hardware to conform to published templates, generally prepared for machine screw installation. Do not provide hardware which has been prepared for self-tapping sheet metal screws, except as specifically indicated.

Furnish screws for installation, with each hardware item. Provide Phillips flat-head screws Finish exposed(under any condition) screws to match the hardware finish or , if exposed in surfaces of other work, to match the finish of such other work as closely as possible, including "prepared for paint" in surfaces to receive, painted finish.

Provide concealed fasteners for hardware units which are exposed when the door is closed, except to the extent no standard units of the type specified are available with concealed fasteners. Do not use through bolts for installation where the bolt head or the nut on the opposite face is exposed in other work, except where it is not feasible to adequately reinforce the work.

LOCK CYLINDERS AND KEYING:

Cylinders: Suppliers to provide interchangeable core rim cylinders at all locksets, deadbolt and panic hardware, where required for proper operation.

General: Supplier shall prepare the keying schedule according to the Owner’s Keying Program and meet with Owner to finalize keying requirements and obtain final instructions in writing.

Keying System: Grandmaster key the locks to the campus, with a new master key for this project.

HARDWARE FINISHES:
Provide matching finishes for hardware units at each door or opening, to the greatest extent possible, and except as otherwise indicated. Reduce differences in color and textures as much as commercially possible where the base metal or metal forming

process is different for individual units of hardware exposed at the same door or opening. In general, match items to the manufacturer's standard finish for the latch and lock set (or push-pull units if no latch-lock sets) for color and texture.

Provide finishes which match those established by EEMA or, if none established, match the Architect's sample.

Provide quality of finish, including thickness of plating or coating (if any), composition, hardness and other qualities complying with manufacturer's standards, but in no case less than specified for the applicable units of hardware by referenced standards.

Provide protective lacquer coating on all exposed hardware finishes of brass, bronze and aluminum, except as otherwise indicated.

The designations used in schedules and elsewhere to indicate hardware finishes are those listed in "Materials & Finishes Standard 1301" by EEMA, including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.

PART 3 - EXECUTION

INSTALLATION:

Mount hardware units at heights indicated in "Recommended Locations for Builders Hardware" by the NEEA, except as specifically indicated or required to comply with governing regulations, and except as may be otherwise directed by Architect.

Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware to a surface which will later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protections with finishing work specified in the Division 9 sections. Do not install surface-mounted items until finishes have been completed on the substrate.

Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

Drill and countersink units which have not been factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

ADJUST AND CLEAN:

Adjust and clean each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.

Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy, return to the work during the week prior to acceptance or occupancy to make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

Instruct Owner's Personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

SECTION 08800 - GLASS AND GLAZING

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Definitions: "Glass" includes prime glass, processed glass, and fabricated glass products. "Glazing" includes glass installation and materials used to install glass. Types of work in this section include glass and glazing for:

Window wall/store front construction, safety or tempered glass.

Entrances and other doors, safety or tempered glass.

"Glass Products" is hereby defined to include glazing plastics.

Packaged mirror units are specified as "specialties" in another section.

QUALITY ASSURANCE:

Prime Glass Manufacturer: One of the following for each type/color/pattern of glass:

ASG Industries, Inc.
C E Glass Division
Ford Glass Company
PPG Industries, Inc.

Prime Glass Standard: FS DD G 451

Heat Treated Glass Standard: FS DD G 1403

Safety Glass Standard: CPSC 16 CFR 1201.

Submit documentation stating the storefront system has been designed to meet a wind pressure defined by the Structural Engineer and Texas Department of Insurance Guidelines.

Impact Resistant Glass: Exterior Doors and Windows:
In addition all exterior glazed openings will need to be specified as impact rated assemblies meeting ASTM E 1886 and ASTM E 1996 for large missile impact.

The contractor shall submit shop drawings and test reports indicating the proposed window and exterior door assemblies meet the noted project design wind pressure requirements. Laminated glazing shall match window and door tested assemblies for glass thickness, heat treatment, and laminate.

SUBMITTALS:

JOB CONDITIONS:
Pre Installation: Meet with Glazier and other trades affected by glass installation, prior to beginning of installation. Do not perform work under adverse weather or job conditions. Install liquid sealants when temperatures are within lower or middle third of temperature range recommended by manufacturer.

PART 2 - PRODUCTS

GLASS PRODUCTS:

INSULATED GLASS UNITS:
Manufacturer is used in this section to refer to a firm that produces primary glass or fabricated glass as defined in the referenced standards.
1. Oldcastle Glass®
2. Guardian Industries
3. Pilkington
4. PPG Industries
5. ACH Float Glass

Materials
Sealed insulating glass units. The sealed insulating glass unit is comprised of a laminated glass unit and a 1/4 " fully tempered glass lite separated by a desiccant-filled spacer system. The laminated glass unit is comprised of (2) 1/4" heat strengthened glass lites with a 0.090 SentryGlass Plus interlayer. The glass thickness and type used in the insulating glass unit shall comply with ASTM E 1300-04. Total Thickness= 1-5/16"

1. Insulating Glass Unit Make-up (Solarban 70 XL)
    - Outboard Lite ¼"
        1. Glass Type: Low-E Coated
        2. Glass Tint: Clear
        3. Glass Strength: (Heat-Strengthened or Tempered)
        4. Coating Orientation: Surface #2
    - Spacer
        1. Nominal Thickness: ½"
        2. Gas Fill: Air
    - Inboard Lite
        1. Glass Type: Uncoated
        2. Glass Tint: Clear
        3. Glass Strength: (Annealed, Heat-Strengthened or Tempered)
        4. Coating Orientation: NA

2. Performance Characteristics (Center of Glass)
(Note: Verify that the glass type and thickness specified matches the Performance Characteristics listed below.)
    - Visible Transmittance: 64%
    - Visible Reflectance: 12%
    - Winter U-Factor (U-Value): 0.28
    - Shading Coefficient (SC): 0.27
    - Solar Heat Gain Coefficient (SHGC): 0.32

3. Provide hermetically sealed IG units with dehydrated airspace, dual sealed with a primary seal of polyisobutylene (PIB), or thermo plastic spacer (TPS) and

a secondary seal of silicone or an organic sealant depending on the application.

FABRICATED GLASS UNITS: At all door lites and interior windows
Laminated Safety Glass (Lmn-G-Sft): Laminate 2 sheets of clear float glass with a 30-mil film of polyvinyl buteral, by manufacturer's standard heat-plus-pressure process with dirt, air pockets and foreign substances excluded; 1/4" thick if not otherwise indicated.
Color: Clear

PROCESSED GLASS:

Tempered Glass, Tempered Glass Mirrors: Provide prime glass of color and type indicated, which has not been heat treated to strengthen glass in bending to not less than 4.5 times annealed strength. Tempered glass is to be provided at all glass areas opening onto corridors and hallways.

GLAZING SEALANTS AND COMPONENTS:

General: Provide color of exposed sealant/compound indicated or if not otherwise indicated, as selected by Architect from manufacturer’s standard colors, or black if no color is so selected. Comply with manufacturer's recommendations for selection of hardness, depending upon the locations of each application, conditions at time of installations, and performance requirements as indicated. Select materials and variations or modifications, carefully for compatibility with surfaces contacted in the installation.

Butyl Rubber Glazing Sealant (BUR GS): Compound of polymerized butyl rubber and inert fillers, solvent based, 75% solids, complying with FS TT S 001657; tack free in 24 hrs. paintable, non-staining.

Preformed Butyl Rubber Glazing Sealant (PBuR GS): Compound of polymerized butyl rubber and inert fillers, with or without polyisobutylene modification, solvent based, 95% solids, formed and coiled on release paper; tack free in 24 hrs., paintable, non-staining; plain, pre-shimmed or reinforced as required for proper installation and setting of glass.

Oleo Resinous Glazing Compound (OR GC): Oil based glazing compound; non-staining and non-bleeding; provide proper type as required for either channel or face glazing; comply with FS TT G 410 for face glazing compound.

GLAZING GASKETS:

Structural Rubber Glazing Gaskets (StR GG): Neoprene extrusions fabricated into frames with molded corner units and zipper lock strips; comply with ASTM C 542.

Molded Neoprene Glazing Gaskets: (MN GG): Molded or extruded neoprene gaskets of the profile and hardness required for water tight construction; comply with ASTM D 2000 designation 2BC 415 to 3BC 620, black.

MISCELLANEOUS GLAZING MATERIALS:
Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.

Setting Blocks: Neoprene or EPDM, 70 90 durometer hardness, with proven compatibility with sealants used.

Spacers: Neoprene or EPDM, 40 50 durometer hardness with proven compatibility with sealants used.

PART 3 EXECUTION

STANDARDS AND PERFORMANCE:
Watertight and airtight installation of each glass product is required, except as otherwise shown. Each installation must withstand normal temperature changes, wind loading, impact loading (for operating sash and doors), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials and other defects in the work.

Protect glass from edge damage during handling and installation, and subsequent operation of glazed components of the work. During installation, discard units with significant edge damage or other imperfections.

Glazing channel dimensions as shown are intended to provide for necessary bite on glass, minimum edge clearance, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by job conditions at time of installation.

Comply with combined recommendations and technical reports by manufacturers of glass and glazing products as used in each glazing channel, and with recommendations of Flat Glass Marketing Association "Glazing Manual", except where more stringent requirements are indicated.

PREPARATION FOR GLAZING:

Clean glazing channel and other framing members immediately before glazing. Remove coatings which are not firmly bonded to substrate. Remove lacquer from metal surfaces where elastomeric sealants are used.

Apply primer or sealant to joint surfaces where recommended by sealant manufacturer.

GLAZING:

Install setting blocks of proper size in sill rabbet, located 1/4th of glass width from each corner. Set blocks in thin course of hell bead compound, if any.

Provide spacers inside and out, of proper size and spacing, for glass sizes larger than 50 united inches, except where gaskets or pre-shimmed tapes are used for glazing. Provide 1/8" minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.

Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.

Voids and Filler Rods: Prevent exudation of sealant or compound by forming voids or installing filler rods in channel at heel of jambs and head (do not leave voids in still channels), except as otherwise indicated and depending on light size, thickness and type of glass, and complying with manufacturer's recommendations.

Force sealants into channels to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.

Tool exposed surfaces of glazing liquids and compounds to provide a substantial "wash" away from glass. Install pressurized tapes and gaskets to protrude slightly out of channel, so as to eliminate dirt and moisture pockets.

Clean and trim excess glazing materials from glass and stops or frames promptly after installation, and eliminate stains and discolorations.

Where wedge shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage to ensure that gasket will not "walk" out when installation is subjected to movement. Anchor gasket to stop with matching ribs, or by proven adhesives, including embedment of gasket tail in cured heel bead.

Gasket Glazing: Miter out and bond ends together at corners where gaskets are used for channel glazing, so that gaskets will not pull away from corners and result in voids or leaks in glazing system.

Structural Gasket Glazing: Cut zipper strips slightly long, to ensure tight closure. Lubricate zipper strip and use special tool to install zipper. Do not lubricate glazing channel or anchorage rabbed. Comply with details as shown and manufacturer's instructions, including the possible use of liquid sealants and weep holes.

CURE PROTECTION AND CLEANING:

Protect exterior glass from breakage immediately upon installation by use of crossed streamers attached to framing and held away from glass. Do not apply markers to surfaces of glass. Remove nonpermanent labels and clean surfaces. Cure sealants for high early strength and durability.

Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.

Wash and polish glass on both faces not more than 4 days prior to date scheduled for inspections intended to establish date of substantial completion in each area of project. Comply with glass product manufacturer's recommendations for final cleaning.

END OF SECTION 08800

SECTION 09250 - GYPSUM DRYWALL

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 General Requirements sections, apply to work of this section.

DESCRIPTION OF WORK:

Types of work include:

Gypsum drywall including screw type metal support system

Drywall finishing (joint tape and compound treatment)

Gypsum Sheathing

QUALITY ASSURANCE:

Fire Resistance Rating: Where gypsum drywall systems with fire resistance ratings are indicated or are required to comply with governing regulations, provide materials and installations identical with applicable assemblies which have been tested and listed by recognized authorities, including UL and AIA.

Gypsum Board Terminology Standard: GA 505 by Gypsum Association.

Single Source Responsibility: Obtain gypsum board products from a single manufacturer, or from manufacturers recommended by the prime manufacturer of gypsum boards.

SUBMITTALS:

Product Data: Submit manufacturer's product specifications and installation instructions for each gypsum drywall component, including other data as may be required to show compliance with these specifications.

DELIVERY, STORAGE AND HANDLING:

Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.

Store materials inside under cover and in manner to keep them dry, protected from weather, direct sunlight, surface contamination, corrosion and damage from construction traffic and other causes. Neatly stack gypsum boards flat to prevent sagging.
Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal corner beads and trim from being bent or damaged.

PROJECT CONDITIONS:

Environmental Requirements, General: Comply with requirements of referenced gypsum board application standards and recommendations of gypsum board manufacturer, for environmental conditions before, during and after application of gypsum board.

Cold Weather Protection: When ambient outdoor temperatures are below 55 degrees F (13 degree C) maintain continuous, uniform, comfortable building working temperatures of not less than 55 degree F (13 degree C) for a minimum period of 48 hours prior to, during and following application of gypsum bard and joint treatment materials or bonding of adhesives.

Ventilation: Ventilate building spaces as required to remove water in excess of that required for drying of joint treatment material immediately after its application. Avoid drafts during dry, hot weather to prevent too rapid drying.

PART 2 PRODUCTS

ACCEPTABLE MANUFACTURERS:

Metal Support Materials:

Gold Bond Building Products Div., National Gypsum Co.
Milcor Division; Inryco Inc.
United States Gypsum Co.

Direct Suspension Systems:

Chicago Metallic Corp.
Donn Corporation.
National Rolling Mills Co.
Roblin Building Products, Inc.
United States Gypsum Co.

Gypsum Board and Related Products:

Gold Bond Building Products Div., National Gypsum Co.
United States Gypsum Co.

METAL SUPPORT MATERIALS:

Ceiling Support Materials and Systems:

General: Size ceiling support components to comply with ASTM C 754 unless indicated otherwise, hot dipped galvanized at exterior walls.

Main Runners: Steel channels with rust inhibitive paint finish, hot or cold rolled.

Hanger Wire: ASTM A 641, soft, Class 1 galvanized.

Hanger Anchorage Devices: Screws, clips, bolts, cast in place concrete inserts or other devices applicable to the indicated method of structural anchorage for ceiling hangers and whose suitability for use intended has been proven through standard construction practices or by certified test data. Size devices for 3x calculated load supported except size direct pull out concrete inserts for 5x calculated loads.

Furring Members: ASTM C 645; 0.0179" min. thickness of base metal, hat shaped.

Where shown as "Resilient", provide manufacturer's special type designed to reduce

sound transmission.

Furring Members: ASTM C 645; 0.0179" min. thickness of base metal, C shaped studs.

Furring Anchorages: 16 gage galvanized wire ties, manufacturer's standard wire type clips, bolts, nails or screws as recommended by furring manufacturer and complying with C 754.

Direct Suspension Systems: Manufacturer's standard zinc coated or painted steel system of furring runners, furring tees, and accessories designed for concealed support of gypsum drywall ceilings; of proper type for use intended.

Wall/Partition Support Materials:

Exterior Studs: Refer to Structural

Interior Studs: ASTM C 645; 0.0179" min. thickness of base metal unless otherwise indicated, 25 gage. Provide 16 gage hot dipped galvanized at exterior walls, unless noted otherwise.

Depth of Section: 4", except as otherwise indicated.

Deflection System: Provide Slotted Deflection Track at all interior partitions.

Suspended Drywall System: Equal to Armstrong Drywall Grid System

Shaft Wall System: Equal to USG Shaftwall System at elevator/mechanical shafts. Provide and install system with C-H profile studs.

Runners: Match studs; type recommended by stud manufacturer for floor and ceiling support of studs, and for vertical abutment of drywall work at other work.

Furring Members: ASTM C 645; 0.0179" min. thickness of base metal, hat shaped. Where shown as "Resilient," provide manufacturer's special type designed to reduce sound transmission.

Z Furring Members: Manufacturer's standard screw type galvanized steel, zee shaped furring members; ASTM A 525, G60, 0.0179" min. thickness of base metal; of depth indicated; designed for mechanical attachment of insulation boards or blankets to monolithic concrete and masonry walls. Hot dipped galvanized at exterior walls.

Fasteners for Furring Members: Type and size recommended by furring manufacturer for substrate and application indicated.

GYPSUM BOARD PRODUCTS:
Gypsum Wallboard: (GypWbd) ASTM C 36, of types, edge configuration and thickness indicated, in maximum lengths available to minimize end-to-end butt joint

Type: USG Gypsum Mold Tough Wallboard, Type MR
Edges: Manufacturer's standard.
Thickness: 1/2” at ceilings, 5/8” at wall partitions, unless otherwise indicated
Uses: at toilet ceilings and wall partitions, where noted.

Type: USG Gypsum Firecode Core Wallboard, Type X
Edges: Manufacturer's standard.
Thickness: 5/8", unless otherwise indicated
Uses: at corridor wall partitions, above 8'-0"aff and where indicated.

Type: USG VHI Firecode Core Wallboard (ASTMC1629 – Passes Level 2 Abrasion Resistance; Level 1 Indention; Level 3 Body Impact)
Thickness: 5/8".
Uses: at all corridor wall partitions to a height of 8'-0"aff and where indicated.

Type: USG Shaft Liner
Thickness: 1".
Uses: at vertical duct penetrations; where indicated.

SHEATHING (wall): shall be Georgia Pacific Dens Glass Gold, 5/8" thick, with taped seams at all exterior applications.

SHEATHING (parapet) shall be Georgia Pacific DensDeck Prime, 5/8" thick, with taped seams, at all parapet roofing applications.

Tile Backer Board: shall be Georgia Pacific, 5/8" thick Dens-Shield Tile Backer with Fire-Shield, provide at all ceramic tile wainscot wall conditions only.

TRIM ACCESSORIES:

General: Provide manufacturer's standard trim accessories of types indicated for drywall work, formed of galvanized steel unless otherwise indicated, with either knurled and perforated or expanded flanges for nailing or stapling, and beaded for concealment of flanges in joint compound. Provide corner beads, L type edge trim beads, U type edge trim beads, special L kerf type edge trim beads, and one piece control joint beads.

Corner bead and Edge Trim for Interior Installation: Comply with ASTM C 840 and the following:

Corner bead formed from zinc alloy, with flanges knurled and perforated or of fine mesh expanded metal.

Steel Edge trim formed from galvanized steel, types per Fig. 1 of ASTM C 840 as follows:

"LC" Bead, unless otherwise indicated.
"LK" Bead with square nose for use with kerfed jambs.
"L" Bead where indicated.
"U" Bead where indicated.

Plastic Edge Trim: Manufacturers standard rigid or semi rigid PVC moldings shaped to provide resilient contact of gypsum board edges with other construction; friction fit, or pressure sensitive adhesive mounting.

One Piece Control Joint: Formed with perforated face flanges connected by vee shaped slot, 1/4 inch wide by approximately 7/16 inch deep and covered with removable tape, fabricated from the following material:

Roll formed zinc.
Extruded vinyl.
Either roll formed zinc or extruded vinyl.

JOINT TREATMENT MATERIALS:

General: ASTM C 475; type recommended by the manufacturer for the application indicated, except as otherwise indicated.

Joint Tape: Paper reinforcing type.

Joint Compound: Vinyl type powder or ready mixed vinyl type for interior use.

Joint Compound: On interior work provide chemical hardening type for bedding and filling, ready mixed vinyl type or vinyl type powder for topping.

MISCELLANEOUS MATERIALS:

General: Provide auxiliary materials for gypsum drywall work of the type and grade recommended by the manufacturer of the gypsum board.

Laminating Adhesive: Special adhesive or joint compound specifically recommended for laminating gypsum boards.

Gypsum Board Screws: Comply with ASTM C 646.

Concealed Acoustical Sealant: Nondrying, non-hardening, non-skinning, non-staining, non-bleeding, gunnable sealant for concealed applications per ASTM C 919.

Sound Attenuation Blankets: Refer to Section 07201 for sound attenuation blanket specification.

Corner Guards: Refer to Section 10260 for Clear Corner Guard specification.

TEXTURE FINISH MATERIALS:
Primer: Of type recommended by manufacturer of texture finish.

Polystyrene Aggregated Finish: One of the following:

QT Imperial Texture Finish: United States Gypsum Co.
Perfect Spray: Gold Bond Bldg. Products Div.
Regular Texture
    Light Monterrey
    Medium Monterrey
    Orange Peel

PART 3 EXECUTION

PREPARATION FOR METAL SUPPORT SYSTEMS
Ceiling Anchorages: Coordinate work with structural ceiling work to ensure that inserts and other structural anchorage provisions have been installed to receive ceiling hangers.

INSTALLATION OF METAL SUPPORT SYSTEMS:

General:
Metal Support Installation Standard: Comply with ASTM C 754.

Do not bridge building expansion joints with support system, frame both sides of joints with furring and other support as indicated.

Ceiling Support Suspension Systems:

Secure hangers to structural support by connecting directly to structure where possible, otherwise connect to inserts, clips or other anchorage devices or fasteners as indicated.

Space main runners 4' 0" o.c. and space hangers 4' 0" o.c. along runners, except as otherwise shown.

Level main runners to a tolerance of 1/8" in 12' 0", measured both lengthwise on each runner and transversely between parallel runners.

Wire tie or clip furring members to main runners and to other structural supports as indicated.

Space furring member 16" o.c., except as otherwise indicated.

Wall/Partition Support Systems:

Install supplementary framing, blocking and bracing at terminations in the work and for support of fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, and similar work to comply with details indicated or if not otherwise indicated, to comply with applicable published recommendations of gypsum board manufacturer, or if not available, of "Gypsum Construction handbook" published by United States Gypsum Co.

Isolate stud system from transfer of structural loading to system, both horizontally and vertically. Provide slip or cushioned type joints to attain lateral support and avoid axial loading.

Install runner tracks at floors, ceilings and structural walls and columns where gypsum drywall stud system abuts other work, except as otherwise indicated.

Extend partition stud system through acoustical ceilings and elsewhere as indicated to the structural support or substrate above the ceiling.

Space studs 16" o.c., unless otherwise indicated.

Frame door openings to comply with detailed indicated or if not otherwise indicated, to comply with applicable published recommendations of gypsum board manufacturer, or if not available, of "Gypsum Construction Handbook" published by United States Gypsum Com. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for jack studs) at head and secure to jamb studs.

Extend vertical jamb studs through suspended ceilings and attach to underside of floor or roof structure above, unless otherwise indicated.

Frame openings other than door openings to comply with details indicated or if not indicated, in same manner as required for door openings; and install framing below sills of openings to match framing required above door heads.
Space wall furring members 16" o.c., unless otherwise indicated.

Erect thermal insulation vertically and hold in place with Z furring members spaced 24" o.c. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails or power drive fasteners spaced 24" o.c. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw attach short flange of furring channel to web of attached channel. Start from this furring member channel with standard width insulation panel and continue in regular manner. At interior corners, space second member no more than 12" from corner and cut insulation to fit. Until gypsum board is installed hold insulation in place with 10" staples fabricated from 18 gage tie wire and inserted through slot in web of member, or by an equally acceptable method.

GENERAL GYPSUM BOARD INSTALLATION REQUIREMENTS:
Gypsum Board Application and Finishing Standards: ASTM C 840 and GA 216.

Where handrails are indicated for direct attachment to gypsum board shaft wall system, provide not less than a 0.0341 inch thick by 4 inch wide galvanized steel reinforcement strip, accurately positioned and secured behind not less than one gypsum board face layer of 1/2 inch or 5/8 inch thickness.

Install sound attenuation blankets as indicated, prior to gypsum board unless readily installed after board has been installed.

Locate exposed end butt joints as far from center of walls and ceilings as possible, and stagger not less than 1' 0" in alternate courses of board.

Install ceiling boards in the direction and manner which will minimize the number of end butt joints, and which will avoid end joints in the central area of each ceiling. Stagger end joints at least 1' 0".

Install wall/partition boards vertically to avoid end butt joints wherever possible. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs.

Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16" open space between boards. Do not force into place.

Located either edge or end joints over supports, except in horizontal applications or where intermediate supports or gypsum board back blocking is provided behind end joints. Position boards so that like edges abut, tapered edges against tapered edges and mill cut or field cut ends against mill cut or field cut ends. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions.

Attach gypsum board to framing and blocking as required for additional support at openings and cutouts.

Form control joints and expansion joints with space between edges of boards, prepared to receive trim accessories.

Cover both faces of steel stud partition framing with gypsum board in concealed spaces (above ceilings, etc.), except in chase walls which are properly braced internally.

Except where concealed application is required for sound, fire, air or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. area, and may be limited to not less than 75% of full coverage.

Isolate perimeter of non load bearing drywall partitions at structural abutments. Provide 1/4" to 1/2" space and trim edge with J type semi finishing edge trim. Seal joints with acoustical sealant. Do not fasten drywall directly to stud system runner tracks.

For double layer partition system, work above acoustical ceilings may be installed with base layer only.

Space fasteners in gypsum boards in accordance with referenced standards and manufacturer's recommendations, except as otherwise indicated.

METHODS OF GYPSUM DRYWALL APPLICATION:
Single layer Application: Install gypsum wallboard.

On ceilings apply gypsum board prior to wall/partition board application to the greatest extent possible.

On partitions/walls apply gypsum board vertically (parallel), unless otherwise indicated, and provide sheet lengths which will minimize end joints.

Double Layer Fastening Methods: Apply base layer of gypsum board and face layer to base layer as follows:

Fasten base layers to supports with screws. Stagger joints on face layers.

INSTALLATION OF DRYWALL TRIM ACCESSORIES:

General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges by nailing or stapling in accordance with manufacturer's instructions and recommendations.

Install metal corner beads at external corners of drywall work.

Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi exposed, and except where plastic trim is indicated. Provide type with face flange to receive joint compound except where semi finishing type is indicated. Install L type trim where work is tightly abutted to other work, and install special kerf type where other work is kerfed to receive long leg of L type trim. Install U type trim where edge is exposed, revealed, gasketed, or sealant filled (including expansion joints).

Install plastic edge trim where indicated on wall panels at juncture with ceilings.

Install metal control joint (beaded type) at all wall openings, at interior structural members and intervals not to exceed 30’-0”, and where indicated otherwise.

FINISHING OF DRYWALL:

General: Apply treatment at gypsum board joints (both directions), flanges of trim accessories, penetrations, fastener heads, surface defects and elsewhere as required to prepare work for decoration. Pre-fill open joints and rounded or beveled edges, using type of compound recommended by manufacturer.

Apply joint tape at joints between gypsum boards, except where a trim accessory is indicated.

Apply joint compound in 3 coats (not including pre-fill of openings in base), and sand between last 2 coats and after last coat.

Refer to sections on painting, coatings and wall coverings in Division 9 for decorative finishes to be applied to drywall work.

APPLICATION OF TEXTURE FINISH:

Surface Preparation and Primer: Prepare and prime drywall and other surfaces in strict accordance with texture finish manufacturer's instructions. Apply primer of proper type to all surfaces to receive texture finish.

Finish Application: Mix and apply finish to drywall and other surfaces indicated to receive finish in strict accordance with manufacturer's instructions to produce a uniform texture without starved spots or other evidence of thin application, and free of application patterns.

Remove any texture droppings or overspray from door frames, windows and other adjoining work.

PROTECTION OF WORK:

Installer shall advise Contractor of required procedures for protecting gypsum drywall work from damage and deterioration during remainder of construction period.

END OF SECTION 09250

SECTION 09300 - TILE

PART 1 - GENERAL

RELATED DOCUMENTS:
Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:
Definition: Tile includes ceramic surfacing units made from clay or other ceramic materials.

Extent of tile work is indicated on drawings and schedules.

Types of tile work in this section include the following:

Glazed Ceramic Tile
Colorbody Porcelain Tile

QUALITY ASSURANCE:
Source of Materials: Provide materials obtained from one source for each type and color of tile, grout and setting materials.

SUBMITTALS
Product Data: Submit manufacturer's technical information and installation instructions for materials required, except bulk materials.

Samples for Initial Selection Purposes: Submit manufacturer's color charts consisting of actual tiles or sections of tiles showing full range of colors, textures and patterns available for each type of tile specified. Include samples of grout and accessories requiring color selection.

Samples for verification purposes: Submit the following:

Samples for each type of tile and for each color and texture required, not less than 12" square, on plywood or hardboard backing and grouted.

Full size samples for each type of trim, accessory and for each color.

Certification: Furnish Master Grade Certificate for each shipment and type of tile, signed by manufacturer and Installer.

PRODUCT HANDLING:
Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Prevent damage or contamination to materials by water, freezing, foreign matter or other causes.

PROJECT CONDITIONS:
Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.

Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.

Maintain temperatures at not less than 50 deg.F (10 deg.) in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

PART 2 PRODUCTS

ACCEPTABLE MANUFACTURERS:
Available Manufacturers:

Glazed Ceramic Tile and Porcelain:
Basis of Design: Daltile
American Olean Tile Co., Div., National Gypsum Co.

Dry Set Grouts: (Non staining)
Custom Building Products.
Laticrete International Inc.
L & M Surco Mfg., Inc.

Commercial Portland Cement Grout: (Non staining)
Custom Building Products.
L & M Surco Mfg. Co., Inc.
TheUpco Co.

PRODUCTS, GENERAL:
ANSI Standard for Ceramic Tile: Comply with ANSI A137.1 "American National Standard Specifications for Ceramic Tile" for types and grades of tile indicated.

ANSI Standard for Tile Installation Materials: Comply with ANSI standard referenced with products and materials indicated for setting and grouting.

Colors, Textures and Patterns: For tile, grout and other products requiring selection of colors, surface textures or other appearance characteristics, provide products to match Characteristics indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standards.

Provide tile trim and accessories which match color and finish of adjoining flat tile.

Mounting: Where factory mounted tile is required provide back or edge mounted tile assemblies as standard with manufacturer unless another mounting method is indicated.

TILE PRODUCTS:
Colorbody Porcelain Tile (Floor and Base): Provide factory mounted flat tile complying with the following requirements:
Type: Porcelain
Series: Porcealto
Nominal Facial Dimensions: 7-13/16 x 7-13/16” (8”x8”)
Color: Labradorite CD49

Glazed Ceramic Tile (Wall): Provide factory mounted flat tile complying with the following requirements:
Type: Glazed Ceramic
Series: Modern Dimensions
Nominal Facial Dimensions: 4 1/4" x 12-3/4". (4”x12”)
Color: Desert Gray X114

Unglazed Quarry Tile: Provide square cage tile complying with the following requirements:

Type: Quarry Tile
Series: Quarry
Nominal Face Dimensions: 6”x6”
Color: Arid Flash 0Q48

Trim Units: Provide tile trim units to match characteristics of adjoining flat tile and to comply with following requirements:

Shapes: As follows, selected from manufacturer's standard shapes:
Base for Portland cement Mortar Installations: Coved.
Base for Thin-set Mortar Installations: Coved.

SETTING MATERIALS:
Portland Cement Mortar Installation Materials: Provide materials to comply with ANSI A108.1 as required for installation method designated, unless otherwise indicated.

Thin set Portland Cement Mortar: Where thin set portland cement mortar applications are indicated, use the following unless otherwise required.

Dry Set Portland Cement Mortar: ANSI A108.5, factory sanded; or latex portland cement mortar, ANSI A108.4.

Organic Adhesive: ANSI A136.1; use Type I for showers, tub recesses, or other areas requiring prolonged water resistance, Type II elsewhere, unless indicated. Provide primer sealer where recommended by manufacturer.

GROUTING MATERIALS:
Commercial Portland Cement Grout: Proprietary Pre-blended compounded composed of portland cement and additives formulated for the type of tile installed.

Dry Set Grout: Proprietary compound composed or portland cement and additives formulated for type of tile installed.

Grout for Pre-grouted Tile Sheets: Same elastomeric material used in factory pre-grouted sheets.

Colors to be selected by Architect form manufacturer’s standard colors.

MISCELLANEOUS MATERIALS:
Metal Edge Strips: Zinc alloy or stainless steel, 1/8" wide at top edge with integral provision for anchorage to mortar bed or substrate, unless otherwise indicated.

Tile Cleaner: DuPont StoneTech Professional Stone & Tile Cleaner

Tile Sealer: DuPont StoneTech Professional Heavy Duty Grout Sealer.

PART 3 - EXECUTION

INSPECTION:
Examine surfaces to receive tile work and conditions under which tile will be installed. Do not proceed with tile work until surfaces and conditions comply with requirements indicated in referenced tile installation standard.

INSTALLATION, GENERAL:
ANSI Tile Installation Standard: Comply with applicable parts of ANSI 108 series of tile installation standards included under "American National Standard Specifications for the Installation of Ceramic Tile".

TCA Installation Guidelines: TCA "Handbook for Ceramic Tile Installation"; comply with TCA installation methods indicated or, if not otherwise indicated, as applicable to installation conditions shown.

Extend tile work into recesses and under or behind equipment and fixtures, to form a complete covering without interruptions, except as otherwise shown. Terminate work neatly at obstructions, edges and corners without disrupting pattern or joint alignments.

Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish or built in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures and other penetrations so that plates, collars, or covers overlap tile.

Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls and trim are same size. Layout tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise shown. For tile mounted in sheets make joints between tile sheets same width as joints within tile sheets so that extent of each sheet is not apparent in finished work.

Grout tile to comply with referenced installation standards, using grout materials indicated.

FLOOR INSTALLATION METHODS:
Ceramic Tile: Install tile to comply with requirements indicated below for setting bed methods, TCA installation methods related to types of sub-floor construction, and grout types:

Portland Cement Mortar: ANSI A108.1.

Bond Coat: Portland cement paste on plastic bed or thin set portland cement on cured bed, ANSI A108.5; at Contractor's option.
Concrete Sub-floors, Interior, Waterproofing Membrane: TCA F121.

Mortar: Sand portland cement
Thin set Portland Cement Mortar: ANSI A108.5
Concrete Sub-floors; Interior: TCA F113.
Grout: Sand portland cement

Conductive Ceramic Mosaic Tile: Install to comply with ANSI A108.7 using conductive dry-set mortar bond coat on damp cured and dried portland cement mortar bed as per TCA F112; grout type as indicated below:

Grout: Sand-portland cement

Paver Tile: Install tile to comply with requirements indicated below for setting bed method, TCA installation method related to types of sub-floor construction, and grout types:

Portland Cement Mortar: ANSI A108.1
Concrete Sub-floor, Interior: TCA F112 (bonded)
Grout: Sand-portland cement.

Metal Edge Strips: Install at locations indicated or where exposed edge of the flooring meets carpet, wood or other flooring which finishes flush with top of tile.

WALL TILE INSTALLATION METHODS:
Install types of tile designated for wall application to comply with requirements indicated below for setting bed methods, TCA installation methods related to subsurface wall conditions, and grout types:

Grout: Dry set.; Thin-set Portland Cement Mortar: ANSI A108.5.
Interior; TCA W213

CLEANING AND PROTECTION:
Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

Unglazed tile may be cleaned with acid solution only when permitted by tile and grout manufacturer's printed instructions, but no sooner than 14 days after installation. Protect metal surfaces, cast iron and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.

Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, un-bonded, or otherwise defective tile work.

Protection: When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage and wear.

Prohibit foot and wheel traffic from using tiled floors for at least 7 days after grouting is completed.

Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

Seal grout in all areas receiving ceramic tile finish.

END OF SECTION 09300

SECTION 09510 - ACOUSTICAL CEILINGS

PART 1 - GENERAL

RELATED DOCUMENTS:
Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:
Extent of each type of acoustical ceiling is shown and scheduled on drawings.

Types of acoustical ceilings specified in this section include the following:
Acoustical panel ceilings, exposed suspension.

QUALITY ASSURANCE:
Installer Qualifications: Firm with not less than three years of successful experience in installation of acoustical ceilings similar to requirements for this project and which is acceptable to manufacturer of acoustical units, as shown by current written statement from manufacturer.

Coordination of Work: Coordinate layout and installation of acoustical ceiling units and suspension system components with other work supported by or penetrating through, ceilings, including light fixtures, HVAC equipment, fire suppression system components (if any), and partition system (if any).

SUBMITTALS:
Product Data: Manufacturer's product specifications and installation instructions for each acoustical ceiling material required, and for each suspension system, including certified laboratory test reports and other data as required to show compliance with these specifications.

DELIVERY, STORAGE, AND HANDLING:
Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination or other causes.

Before installing acoustical ceiling units, permit them to reach room temperature and stabilized moisture content.

Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

PROJECT CONDITIONS:
Space Enclosure: Do not install interior acoustical ceilings until space is enclosed and weatherproof, wet work in space is completed and nominally dry, work above ceilings completed, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

PART 2 - PRODUCTS

ACOUSTICAL CEILING UNITS, GENERAL:
Standard for Acoustical Ceiling Units: Provide manufacturer's standard units of configuration indicated which are prepared for mounting method designated and which comply with FS SS S 118 requirements, including those indicated by reference to type,

form, pattern, grade (NRC or NIC's as applicable), light reflectance coefficient (LR), edge detail, and joint detail (if any).

Sound Attenuation Performance: Provide acoustical ceiling units with ratings for ceiling sound transmission class (STC) of range indicated as determined according to AMA 1 II "Ceiling Sound Transmission Test by Two Room Method" with ceilings continuous at partitions and supported by a metal suspension system of type appropriate for ceiling unit of configuration indicated (concealed for tile, exposed for panels).

Colors, Textures, and Patterns: Provide products to match appearance characteristics indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors, surface textures, and patterns available for acoustical ceiling units and exposed metal suspension system members of quality designated.

ACOUSTICAL PANELS:

SAC I Panels Mineral Composition with Standard Washable painted finish:
Nodulated, Cast or Molded Units, Fissured: Form 2, Pattern d, NRC 60, LR 1, STC 30-34 Square edge, white, 24" x 24" x 5/8". No. 1728 Panels:
Fine-Fissured - Armstrong World Ind., Inc.

SAC II Panels Mineral Composition with Standard Washable painted finish:
Nodulated, Cast or Molded Units, Fissured: Form 2, Pattern d, NRC 60, LR 1, STC 30-34 tegular edge, white, 24" x 24" x 5/8". No. 1734 Panels:
Fine-Fissured Tegular - Armstrong World Ind., Inc.

SAC III Panels - Other (Panel Material as indicated below).
High Density Ceramic Composition Units with Scrubbable Finish: Resistant to heat, moisture, and corrosive fumes; suitable for exterior applications; Pattern/NRC as indicated below; LR1 (0.75); STC 40-44, square edge, white, 24" X24" X 5/8" or as indicated. Provide locking hold down clips at all toilets.
Ceramaguard RH100 Fire Rated #607- Armstrong World Industries, Inc.

SAC IV Panels Mineral Composition with Standard Washable painted finish:
Vinyl Faced Units, perforated, NRC 55, LR .79, CAC 335, Lay-in, white, 24" x 24" x 5/8". No. 1715 Panels:
Clean Room Mylar, Armstrong World Industries, Inc.

SAC V Panels Mineral Composition with Standard Washable painted finish:
Vinyl Faced Units, Un-perforated, NRC 55, LR .79, CAC 335, Lay-in, white, 24" x 24" x 5/8". No. 868 Panels:
Clean Room VL, Armstrong World Industries, Inc.

Upon completion of project, the Contractor shall provide the Owner with two boxes of ceiling tile for each style used for future repairs.

METAL SUSPENSION SYSTEMS, GENERAL:

Standard for Metal Suspension Systems: Provide metal suspension systems of type, structural classification and finish indicated which comply with applicable ASTM C 635 requirements.

Finishes and Colors: Provide manufacturer's standard finish for type of system indicated, unless otherwise required. For exposed suspension members and accessories with painted finish, provide black color.

High Humidity Finish: Comply with ASTM C 635 requirements for Coating Classification for "Severe Environment Performance" where high humidity finishes are indicated.

Attachment Devices: Size for 5 times design load indicated in ASTM C 635, Table 1, Direct-Hung.

Hanger Wire: Galvanized carbon steel wire, ASTM A 641, soft temper, pre-stretched, Class 1 coating, sized so that stress at 3 times hanger design loan (ASTM C 635, Table 1, Direct Hung), will be less than yield stress of wire, but provide not less than 12 gage.

Edge Moldings and Trim: Metal or extruded plastic of types and profiles indicated or, if not indicated, provide manufacturer's standard molding for edges and penetrations of ceiling which fits with type of edge detail and suspension system indicated.

Available Manufacturers: Manufacturers of Steel Exposed Suspension Systems: (in air-conditioned areas)
Same as acoustical unit manufacturer:
Chicago Metallic Corp.
Donn Corp.
National Rolling Mills, INc.

EXPOSED METAL DIRECT HUNG SUSPENSION SYSTEM:
Fire Rated Double Web Suspension System: 15/16”
Finish: Aluminum cap painted white.

Structural Classification: Intermediate Duty System: 15/16”
Finish: Aluminum cap painted white.

Structural Classification: Intermediate Duty System: 9/16”
Finish: Aluminum cap painted white.

PART 3 - EXECUTION

PREPARATION:
Coordination: Furnish layouts for inserts, clips, or other supports required to be installed by other trades for support of acoustical ceilings.

Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans wherever possible.

INSTALLATION:
General: Install materials in accordance with manufacturer's printed instructions, and to comply with governing regulations, fire resistance rating requirements as indicated, and industry standards applicable to work.

Arrange acoustical units and orient directionally patterned units (if any) in manner shown by reflected ceiling plans.

Install tile with pattern running in alternating one direction.

Install suspension systems to comply with ASTM C 636, with hangers supported only from building structural members. Locate hangers not less than 6" from each end and

spaced 4'-0" along each carrying channel or direct hung runner, unless otherwise indicated, leveling to tolerance of 3/32" in 12'-0".

Secure wire hangers by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices which are secure and appropriate for substrate, and which will not deteriorate or fail with age or elevated temperatures.
.
Install hangers plumb and free from contact with insulation or other objects within ceiling plenum which are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal force by bracing, counter splaying or other equally effective means.

Install edge moldings of type indicated at perimeter of acoustical ceiling area and at locations where necessary to conceal edges of acoustical units.

Screw attached moldings to substrate at intervals not over 16” o.c. and not more than 3" from ends, leveling with ceiling suspension system to tolerance of 1/8" in 12' 0". Miter corners accurately and connect securely.

Install acoustical tile in coordination with suspension system. Place splines or flanges of suspension system into kerfed edges, or insert tile tongues into tile grooves, so that every tile to tile joint is closed by double lap of material.

Fit adjoining tile to form flush, tight joints. Scribe and cut for accurate fit at borders and around penetrating work.

Install acoustical panels in coordination with suspension system, with edges concealed by support of suspension members. Scribe and cut panels to fit accurately at borders and at penetrations.

ADJUST AND CLEAN:
Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members; comply with manufacturer's instructions for cleaning and touch up of minor finish damage.

Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09510

SECTION 09642 – GYMNASIUM WOOD FLOORING

PRO ACTION THRUST

PART 1 - GENERAL

1.01 Description

A. The information herein details a low profile cushioned system comprised of two layers of plywood crossed and fastened together with ProAction variable load response pads affixed to the bottom and maple strip flooring nailed to the top.
B. The flooring system assembly shall meet DIN 18032 Part 2.
C. The general contractor shall provide a level, steel troweled slab to a tolerance of +/- 1/8" (3mm) in a 10'0" (3m) radius and subject to the approval of the wood floor contractor. Moisture barriers must be adequate for conditions. The concrete slab is to be depressed 1-3/4"(44mm) plus the thickness of the flooring specified.

1.02 Quality Assurance

A. All system component parts must be supplied by Action Floor Systems, LLC.
B. The flooring contractor must be approved by Action Floor Systems, LLC.
C. Flooring materials must be allowed to acclimate to building conditions on the jobsite in a dry, well-ventilated area, not in contact with masonry, and shall be installed at a moisture content not to exceed 8% except in areas of constant high humidity where the moisture content of the flooring shall not exceed 10%.

1.03 Working Conditions

A. The wood flooring shall not be installed until all masonry, plastering, tile, marble and terrazzo work is completed, and overhead mechanical trades and painters have finished in wood floor area. The building must be reasonably dry; all openings must be closed in; permanent heating and air conditioning installed and operating.
B. The subfloor shall be dry, free of foreign materials, and turned over to the wood flooring contractor broom clean. Moderate room temperature of 65 degrees (18C) or more shall be maintained a week preceding and throughout the duration of the work. Humidity conditions within the building shall approximate humidity conditions which will prevail when the building is occupied. Care should be taken to maintain humidity within the range of 35% to 50%.

1.04 Warranty

A. Action Floor Systems, LLC warrants the material it ships to be free from defects in materials and workmanship for a period of one year and the flooring installer warrants the installation of the flooring to be free of defects in materials and workmanship for a period of one year. The exclusive remedy under this warranty shall be replacement of defective material supplied by Action Floor Systems, LLC or correction of defective installation by the flooring installer. All implied warranties of merchantability or fitness for intended use are limited to the period of this warranty. This warranty excludes consequential damages.
B. This warranty does not cover damage caused by fire, winds, floods, chemicals or other abuse, or by failure of other contractors to adhere to specifications, or neglect of reasonable precaution to provide adequate ventilation during hot and humid weather. This warranty also excludes damage due to excessive dryness or excessive moisture from humidity, spillage, migration through the slab or wall or any other source. This warranty also excludes damage to floors due to ordinary wear and tear, faulty construction of the building, (other than the flooring

installation), separation of the concrete slab underlying the floor, settlement of the walls, or use of water on the floor.

C. During the warranty period, the floor cannot be coated without the permission of the floor contractor.

PART 2 – PRODUCTS

2.01 Materials

A. Flooring
   1. Flooring shall be northern hard maple strip flooring, 25/32" x 2-1/4" (20mm x 57mm) MFMA grade marked and stamped as manufactured by Action Floor Systems, LLC.
   2. Grades available are MFMA 1st, 2nd&Btr., 3rd&Btr., and 3rd grade.
   3. Random Length Maple Flooring

B. Subfloor
   1. Vapor retarder shall be 6-mil polyethylene.
   2. The pads shall be ProAction 3/4" (19mm) variable load response pads.
   3. Panels shall be 15/32" (12mm) thick, CD face, exposure 1, 4-ply rated plywood.
   4. Subfloor fasteners shall be 1" (25mm) cleats or 16-gauge staples.
   5. Flooring fasteners shall be 2" (50mm) cleats or staples.
   6. Wall base shall be 3" x 4" (76mm x 102mm) vented cove base with premolded corners (Black), as supplied by Action Floor Systems, LLC.

PART 3 – EXECUTION

3.01 Inspection

A. Inspect concrete slab for proper tolerance and dryness reporting any discrepancies in writing to the general contractor.

B. All work to put the concrete slab in acceptable condition shall be the responsibility of the general contractor.

3.02 Installation

A. Cover concrete slab with poly, lap edges 6" (150mm) and seal.

B. ProAction pads shall be attached to the underside of the first layer of plywood as specified by the manufacturer.

C. Place the first layer of plywood diagonal or perpendicular to the intended direction of the flooring, allow 1/4" (6mm) spacing all edges.

D. Lay the second layer of plywood without pads at a diagonal or the opposite 45-degree angle to the first layer. No joints in the second layer shall coincide with a joint in the first layer. Fasten layers together, nail or staple with 1" (25mm) fasteners starting from the center of the sheet working outward fastening 12" (300mm) on-center, and fasten 6" (150mm) on-center at sheet perimeter. Allow 1/4" (6mm) between panels at perimeter edges and a 2" (50mm) expansion void at walls and all vertical obstructions.

E. Machine nail strip flooring into the subfloor parallel to the long dimension of the area. Provide adequate expansion at regular intervals across the floor during installation as dictated by the average humidity conditions of the area according to the recommendations of the local Action Floor Systems, LLC flooring contractor. Provide 2" expansion voids at perimeters and all vertical obstructions. Install ventcove base over perimeter voids and metal thresholds at doorways.

3.03 Floor Sanding

A. Use coarse, medium and fine grade sandpaper.
B. After sanding with drum sander, buff entire floor using 100 grit screenback or equal grit sandpaper, with a heavy-duty buffing machine.
C. Vacuum or tack floor before first coat of finish.
D. Floor shall present a smooth surface without drum stop marks, gouges, streaks or shiners.

3.04 Finishing

A. Inspect entire area of floor to ensure that the surface is acceptable for finishing, completely free from sanding dust and perfectly clean.
B. Apply seal and finish per manufacturer's instructions.
C. Screenback or steel wool and vacuum or tack between each coat after it dries.
D. Apply game lines accurately after the seal coat, after buffing and vacuuming. Lay out in accordance with drawings. For game lines, use current rules of association having jurisdiction. Lines shall be straight with sharp edges in colors selected by the architect. Game line paint shall be compatible with finish.

3.05 Base Installation

A. Affix rubber base to wall with recommended adhesive or screws.
B. Miter all corners carefully. Use premolded outside corners.

3.06 Clean Up

A. Clean up all unused materials and debris and remove from premises.

3.07 Maintenance

Upon completion of floor installation, the owners, attendants or individuals in charge and responsible for the upkeep of the building are to see that the care and maintenance instructions of the MFMA are followed. Failure to do so may void warranty.

END OF SECTION 09642

SECTION 09650 - RESILIENT FLOORING

PART 1 - GENERAL

RELATED DOCUMENTS:
Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:
Extent of resilient flooring and accessories is shown on drawings and in schedules.
Floor Wax

QUALITY ASSURANCE:
Manufacturer: Provide each type of resilient flooring and accessories as produced by a single manufacturer, including recommended primers, adhesives, sealants, and leveling compounds.

Wherever possible, provide required resilient flooring and accessories produced by a single manufacturer.

SUBMITTALS:
Product Data: Submit 2 copies of manufacturer's technical data and installation instructions for each type of resilient flooring and accessory.

Samples: Submit, for verification purposes, samples of each type, color, and pattern of resilient flooring, including accessories, required, indicating full range of color and pattern variation.

Maintenance Instructions: Submit 2 copies of manufacturer's recommended maintenance practices for each type of resilient flooring and accessory required.

Replacement Material: After completion of work, deliver to project site replacement materials from same manufactured lot as materials installed, and as follows:

Tile flooring, not less than one box for each 50 boxes or fraction thereof, for each type, size, and color installed.

JOB CONDITIONS:
Maintain minimum temperature of 65 degrees F (18 degrees C) in spaces to receive resilient flooring for at least 40 hours prior to installation, during installation, and for not less than 48 hours after installation. Store resilient flooring materials in spaces where they will be installed for at least 48 hours before beginning installation. Subsequently, maintain minimum temperature of 55 degrees F (13 degrees C) in areas where work is completed.

Install resilient flooring and accessories after other finishing operations, including painting, have been completed. Do not install resilient flooring over concrete slabs until the latter have been cured and are sufficiently dry to achieve bond with adhesive as determined by manufacturer's recommended bond and moisture test.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS:
Available manufacturers must have thru-chip technology or equal manufacturing technology.

Vinyl Composition Tile:
Basis of Design: Armstrong World Industries, Inc. - All available colors including Multi-colors

Selected Colors:

52505 Harlequin White
51812 Lemon Yellow
57508 Blue Dreams
51903 Blue Grey

Tarkett Inc. - Signals, Collage, Expressions/Basics available.
Mannington Commercial - Essentials and Designer Essentials.
Azrock Commercial Flooring - Cortina/Compliments

Rubber Wall Base:
Basis of Design: Flexco Floors

Selected Color: 058 Blue Shadow

Johnson Rubber Co., Inc., Flooring Accessories Div.
R. C. Musson Rubber Co., Inc.
Roppe Rubber Corp.

MATERIALS:
Colors and Patterns: As shown or scheduled, or as selected by Architect from manufacturer's standards.

Tile Flooring:
Vinyl Composition Tile (VCT): FS SS T 312, Type IV; 12" x 12" unless otherwise indicated, and as follows:

Composition 1 asbestos-free.
Gage: 1/8".
Provide four (4) color pattern as shown on plans.

Raised Rubber Sheet Flooring at Stairwell Landing and Elevator Cab:
Basis of Design: Flextones Rubber Flooring – Color: 058 Blue Shadow.

Floor tiles to meet ASTM F-1344 standard specification for rubber floor tile designation: IA. ADA slip resistance.

Size:	18-1/8" x 18-1/8"
Tile Type:	Round
Gage:	3.18 mm
Color:	standard colors available (solids)

Stair Treads:
Basis of Design: Stair treads to equal Flexco #550 – Color: 058 Blue Shadow.

Accessories:
Basis of Design: Wall Base equal to Flexco #2000 – Color: 058 Blue Shadow.

Wall Base (WL BS): Provide rubber base complying with FS SS W 40, Type I, with matching end stops and preformed corner units, and as follows:

Height: 4".
Thickness: 1/8" gage.
Style: Standard top set cove.
Finish: Matte.

Transition strip:
Provide 1" wide transition strips between all differing floor conditions.
Provide 1" transition strips at all door openings.

Adhesives (Cements): Waterproof, stabilized type as recommended by flooring manufacturer to suit material and substrate conditions.

Concrete Slab Primer: Non staining type as recommended by flooring manufacturer.

Leveling Compound: Latex type as recommended by flooring manufacturer.

Floor Wax:

Basis of Design: iShine High Solids Floor Finish – Spartan Chemical Company, Inc.

Total Solids – 34.5%
Non-Volatile Solids – 25%
pH (Concentrate) 8.0-9.0

Install per Manufactures written directions for preparation and installation of product

Provide and install total of (7) coats of floor finish.

PART 3 - EXECUTION

PREPARATION:

Broom clean or vacuum surfaces to be covered, and inspect sub-floor. Start of flooring installation indicates acceptance of sub-floor conditions and full responsibility for completed work.

Use leveling compound as recommended by flooring manufacturer for filling small cracks and depressions in sub-floors.

Perform moisture tests on concrete slabs to determine that concrete surfaces are sufficiently cured and ready to receive flooring.

Apply concrete slab primer, if recommended by flooring manufacturer, prior to application of adhesive. Apply in compliance with manufacturer's directions.

INSTALLATION:

General:
Install flooring using method indicated in strict compliance with manufacturer's recommendations. Extend flooring into toe spaces, door reveals, and into closets and similar openings.

Maintain reference markers, holes, or openings that are in place or plainly marked for

future cutting by repeating on finish flooring as marked on sub-floor. Use chalk or other non-permanent marking device.

Install flooring on covers for telephone and electrical ducts, and other such items as occur within finished floor areas.

Maintain overall continuity of color and pattern with pieces of flooring installed on these covers. Tightly cement edges to perimeter of floor around covers and to covers.

Tightly cement flooring to sub-base without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections. Hand roll flooring at perimeter of each covered area to assure adhesion.

Tile Floors:
Lay tile from center marks established with principal walls, discounting minor offsets, so that tile at opposite edges of room are of equal width. Adjust as necessary to avoid use of cut widths less than 1/2 tile at room perimeters. Lay tile square to room axis, unless otherwise shown.

Match tiles for color and pattern by using tile from cartons in same sequence as manufactured and packaged. Cut tile neatly around all fixtures. Broken, cracked, chipped, or deformed tiles are not acceptable.

Lay tile in "checkerboard" fashion with grain reversed in adjacent tiles.

Adhere tile flooring to substrates using full spread of adhesive applied in compliance with flooring manufacturer's directions.

Accessories:
Apply wall base to walls, columns, pilasters, casework and other permanent fixtures in rooms or areas where base is required. Install base in lengths as long as practicable, with preformed corner units, or fabricated from base materials with metered or coped inside corners. Tightly bond tile to substrate throughout length of each piece to provide continuous contact at horizontal and vertical surfaces.

On masonry surfaces, or other similar irregular surfaces, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.

Place resilient edge strips tightly butted to flooring and secure with adhesive. Install edging strips at edges of flooring which, when changed to different floor material, would otherwise be exposed.

FLOOR WAXING:
Upon completion of floor installation and before applying first coat of floor finish, contractor to coordinate a pre-installation meeting with Owner to determine installation schedule and procedures. Owner will be notified and be present for initial application and will provide approval for each subsequent application per a schedule that is set up by the Owner and coordinated with General Contractor.

- First (1) coat of floor finish to all areas to allow for initial punch list inspection and allow Owner to inspect installation procedures.
- Remaining Six (6) coats of floor finish will be installed per Owner schedule and coordinated with General Contractor.

CLEANING AND PROTECTION:
Remove any excess adhesive or other surface blemishes, using neutral type cleaners as recommended by flooring manufacturer. Protect installed flooring with heavy Kraft paper or other covering.

Finishing: After completion of project and just prior to final inspection of work, thoroughly clean floors and accessories.

END OF SECTION 09650

SECTION 09900 PAINTING

PART 1 GENERAL

RELATED DOCUMENTS:
Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work in this section.

DESCRIPTION OF WORK:
Extent of painting work is indicated on drawings and schedules, and as herein specified.

Work includes painting and finishing of interior and exterior exposed items and surfaces throughout Project, except as otherwise indicated.

Surface preparation, priming and coats or paint specified are in addition to shop priming and surface treatment specified under other sections of work.

"Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

Paint exposed surfaces whether or not colors are designated in “schedules", except where natural finish of material is specifically noted as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas. If color or finish is not designated, Architect will select these from standard colors available for materials systems specified.

Pre Finished Items: Unless otherwise indicated, do not include painting when factory finishing or installer finishing is specified for such items as (but not limited to) metal toilet enclosures, pre-finished partition systems, acoustic materials, architectural woodwork and casework, finished mechanical and electrical equipment, including light fixtures, switchgear and distribution cabinets, elevator entrance frames, doors and equipment.

Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, foundation spaces, furred areas, utility tunnels, pipe spaces, duct shafts and elevator shafts.

Finished Metal Surfaces: Unless otherwise indicated, metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting.

Operating Parts: Unless otherwise indicated, moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor and fan shafts will not require finish painting.

Do not paint over any code required labels, such as Underwriters’ Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

SUBMITTALS:

Product Data: Submit manufacturer's technical information including Paint label analysis

and application instructions for each material proposed for use.
Samples: Submit samples for Architect's review of color and texture only. Provide a listing of material and application for each coat of each finish sample.

On 12" x 12" hardboard, provide two samples of each color and material, with texture to simulate actual conditions. Resubmit samples as requested by Architect until acceptable sheen, color, and texture is achieved.

On actual wood surfaces, provide two 4" x 8" samples of natural and stained wood finish. Label and identify each as to location and application.

On concrete masonry, provide two 4" square samples of masonry for each type of finish and color, defining filler, prime and finish coat.

DELIVERY AND STORAGE:
Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name and label, and following information:

Name or title of material.
Fed. Spec. number, if applicable.
Manufacturer's stock number and date of manufacture.
Manufacturer's name.
Contents by volume, for major pigment and vehicle constituents.
Thinning instructions.
Application instructions.
Color name and number.

JOB CONDITIONS:

Apply water base paints only when temperature of surfaces to be painted and surrounding air temperatures are between 50 degrees F (10 degrees C) and 90 degrees F (32 degrees C), unless otherwise permitted by paint manufacturer's printed instructions.

Apply solvent thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45 degrees F (7 degrees C) and 95 degrees F (35 degrees C), unless otherwise permitted by paint manufacturer's printed instructions.

Do not paint in snow, rain, fog or mist, or when relative humidity exceeds 85%, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.

Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.

PART 2 PRODUCTS

COLORS AND FINISHES:
Paint colors, surface treatments, and finishes, are indicated in "schedules" of the contract documents.

Prior to beginning work, Architect will furnish color chips for surfaces to be painted.

Use representative colors when preparing samples for review.

MANUFACTURERS: for interior paint system only;

Sherwin Williams
Technical Coatings Inc.
Jones Blair
Pittsburgh Paint

For exterior paint system:
Tnemec (no substitutes for this product)

Color Pigments: Pure, non-fading, applicable types to suit substrates and service indicated.

Paint Coordination: Provide finish coats which are compatible with prime paints used. Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information on characteristics of finish materials proposed for use, to ensure compatible prime coats are used. Provide barrier coats over incompatible primers or remove and re-prime as required. Notify Architect in writing of any anticipated problems using specified coating systems with substrates primed by others.

MATERIALS:
Material Quality: Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best grade product will not be acceptable.

EXTERIOR PAINT SYSTEMS (EPS):
Provide following paint systems for various substrates, as indicated.

General Paint Wood:

EPS-1 1st coat - Primer undercost (T-P-25).
2nd coat - Acrylic emulsion (TT-P-19).
3nd coat - Acrylic emulsion (TT-P-19).

Painted Wood Trim:

EPS-2: 1st coat - Primer undercoat (TT-P-25).
2nd coat - Alkyd trim enamel (TT-P-37).
3rd coat - Alkyd trim enamel (TT-P-37).

Painted Plywood:

EPS-3 1st coat - Surface sealer (TT-S-176).
2nd coat - Primer undercoat (TT-P-25).
3rd coat - Acrylic emulsion (TT-P-19).
4th coat - Acrylic emulsion (TT-P-19).

INTERIOR PAINT SYSTEMS:
Provide following paint systems for various substrates, as indicated.

Exposed Metal:
IPS2: 1st Coat - PROMAR Interior Latex Primer
2nd Coat - PROMAR 200 Interior Latex Semi-Gloss
3rd Coat - PROMAR 200 Interior Latex Semi-Gloss

Gypsum Drywall Systems – (General Use):
1st Coat - Interior Latex Based Primer Coat (FS TT-P-650).
2nd Coat & 3rd Coat - Odorless interior semi-gloss latex enamel (TS TT-E-509). Not less than 2.5 mils dry film thickness.

Gypsum Drywall Systems:
Provide DUROPLEX® Textured Acrylic Coating system as manufactured by TRIARCH. www.triarchinc.com; 1.800.537.6111
Texture to be: Tight Knock Down Fissured. Three (3) colors will be chosen Eliminate Semi-Gloss Sealer and apply (1) coat SW 6001Grayish (Field Paint) over Duroplex system.

Painted Wood Work and Hardboard:
IPS-6: 1st Coat - Enamel Undercoat.
2nd Coat- Semi-gloss enamel.
3rd Coat - Semi-gloss enamel

Stained Woodwork:
IPS-5: 1st Coat - Exterior oil stain.
2nd Coat - Bleached Shellac.
3rd Coat - Rubbing Varnish.
4th Coat - Rubbing Varnish.

Surface Preparation: Wood must be dry and cleaned of dirt, grease, wax, polish, and marks. Old finishes in poor condition should be completely removed and the surface treated as a new surface (this shall apply to existing floors only). Sand wood to a smooth surface using 100-120 grit paper. If wood is stained, sand carefully to avoid sanding through the color. Remove sanding dust with a vacuum, no dust cloths shall be permitted. New wood should be stored inside fora minimum of 24 hours prior to staining. Stain or varnish applied to wood that has not been dried can exhibit blotching, discoloration, or cracking.

PART 3 EXECUTION
INSPECTION:
Applicator must examine areas and conditions under which painting work is to be applied and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been correct in a manner acceptable to Applicator.

Starting of painting work will be construed as Applicator's acceptance of surfaces and conditions within any particular area.

Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

SURFACE PREPARATION:

General: Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition.

Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish painted, or provide surface applied protection prior to surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.

Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly painted surfaces.

Cementitious Materials: Prepare cementitious surfaces of concrete, concrete block to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze as required. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint. Do not paint over surfaces where moisture content exceeds that permitted in manufacturer’s printed directions.

Clean concrete floor surfaces scheduled to be painted with a commercial solution or muriatic acid, or other etching cleaner. Flush floor with clean water to neutralize acid, and allow to dry before painting.

Wood: Clean wood surfaces to be painted of dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view, and dust off. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer, before application of priming coat. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sandpaper smooth when dried.

Prime, stain, or seal wood required to be job painted immediately upon delivery to job. Prime edges, ends, faces, undersides, and backsides of such wood, including cabinets, counters, cases, paneling. When transparent finish is required, use spar varnish for back-priming.

Back-prime paneling on interior partitions only where masonry or other wet wall construction occurs on backside.

Seal tops, bottoms, and cut outs of unprimed wood doors with a heavy coat of varnish or equivalent sealer immediately upon delivery to job.

Ferrous Metals: Clean ferrous surfaces, which are not galvanized or shop coated, of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.

Touch up shop applied prime coats wherever damaged or bare, where required by other sections of these specifications. Clean and touch up with same type shop primer.

Galvanized Surfaces: Clean free of oil and surface contaminants with non petroleum based solvent.

MATERIALS PREPARATION:

Mix and prepare painting materials in accordance with manufacturer's directions.

Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue. Store materials not in actual use in tightly covered containers.

Stir materials before application to produce a mixture of uniform density, and stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

APPLICATION:
General: Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Give special attention to insure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.

Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint. Paint back sides of access panels, and removable or hinged covers to match exposed surfaces.

Finish exterior doors on tops, bottoms and side edges same as exterior faces, unless otherwise indicated. Sand lightly between each succeeding enamel or varnish coat.

Omit first coat (primer) on metal surfaces which have been shop primed and touch up painted, unless otherwise indicated.

Scheduling Painting: Apply first coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firms, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated or, if not indicated, as recommended by coating manufacturer.

Prime Coats: Apply prime coat of material which is required to be painted or finished, and which has not been prime coated by others.

Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn through or other defects

due to insufficient sealing.

Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularity in texture, skid marks, or other surface imperfections.

Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.

Transparent (Clear) Finish: 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, unless otherwise indicated.

Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

FIELD QUALITY CONTROL:
The right is reserved by Owner to invoke the following material testing procedure at any time, and any number of times during period of field painting:

Engage services of an independent testing laboratory to sample paint being used. Samples of materials delivered to project site will be taken, identified and sealed, and certified in presence of Contractor.

Testing laboratory will perform appropriate tests for any or all of following characteristics: Abrasion resistance, apparent reflectivity, flexibility, washability, absorption, accelerated weathering, dry opacity, accelerated yellowness, recoating, skinning, color retention, alkali resistance and quantitative materials analysis.

If test results show that material being used does not comply with specified requirements, Contractor may be directed to stop painting work, and remove non complying paint; pay for testing; repaint surfaces coated with rejected paint; remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are non compatible.

CLEAN UP AND PROTECTION:
Clean Up: During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each work day. Upon completion of painting work, clean window glass and other paint spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using car not to scratch or otherwise damage finished surfaces.

Protection: Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations. At completion of work of other trades, touch up and restore all damaged or defaced painted surfaces.

END OF SECTION 09900

SECTION 10100 - MARKERBOARDS AND TACKBOARDS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to the work of this section.

DESCRIPTION OF WORK:

Extent of marker boards (MKBD) and tack boards (TKBD) is shown on drawings.

Types of, marker boards and tack boards specified in this section include the following:
Magnetic Marker boards

QUALITY ASSURANCE:

Manufacturer: Unless otherwise acceptable to Architect, furnish all marker boards and tack boards by one manufacturer for the entire project.

SUBMITTALS:

Product Data: Submit manufacturer's technical data and installation instructions for each material and component part, including data substantiating that materials comply with requirements.

Samples: Submit full range of color samples for each type of marker board, tack board, trim and accessory required. Provide 12" square samples of sheet materials and 12" lengths of trim members for color verification after selections have been made.

Shop Drawings: Submit for each type of marker board and tack board. Include sections of typical trim members and dimensioned elevations. Show anchors, grounds, reinforcement, accessories, and installation details.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS:

Manufacturers: Subject to compliance with requirements, provide products of one of the following:

Manufacturers of Markerboards:
Basis of Design: Nelson Adams NACO
Color: White
Best-Rite.
Claridge Products and Equipment, Inc.
Greensteel, Inc.
Tacrite

Manufacturers of Tackboards:
Basis of Design: Nelson Adams NACO
Color: French Blue B321-71
Claridge Products and Equipment, Inc.

Greensteel, Inc.
Tacrite
Polyvision

Manufacturers of Tack Strips
Basis of Design: Nelson Adams NACO
Color: French Blue B321-71
Claridge Products and Equipment, Inc.
Greensteel, Inc.
Tacrite
Polyvision

MATERIALS:

Colors and Textures: Provide as shown or scheduled. If not indicated on drawings, provide colors and textures as selected by Architect from manufacturer's standards.

Magentic Markerboards (MKBD):

Porcelain on Metal: LCS 24 gauge Porcelain Enamel Steel, over 1/4" hardboard. Units to be fabricated in accordance with the Performance Specifications for porcelain enamel steel marker boards, as established by the Porcelain Enamel Institute, the enamel should be;

* Applied automatically to a uniform thickness
. * Fired under rigidly controlled temperatures
* Fused permanently to the steel
* Height is 4' by length shown on plans.

Cover Coat Finish: Manufacturer's special writing surface (SWS) with gloss finish intended for use with liquid markers. Surface must be magnetic.

Core: Hardboard of thickness 1/4".
Particle board accepted only in thicknesses of 3/8".

Laminating Adhesive: Manufacturer’s standard moisture-resistant thermoplastic type adhesive.

Tackboards (TKBD):

Vinyl Fabric-Faced: Provide mildew resistant, vinyl fabric complying with FS CCC-W-408, Type II, laminated to 1/4" thick cork backing sheet.

Unless otherwise indicated, make up rigid panels by factory-laminating under pressure to 1/4" thick exterior type plywood or hardboard backing. Height is 4' by length shown in plans. Provide continuous map rail above these units as well, see interior elevations.

TRIM AND ACCESSORIES:

Provide one (1) Flag Holders model no. 51FH per marker board, single or combo unit

General: Fabricate frames and trim of not less than 0.062" thick aluminum alloy, size and shape as indicated, to suit type of installation. Provide straight, single length units wherever possible; keep joints to a minimum. Miter corners to a neat, hairline closure.

Clear Anodized Finish: Manufacturer's standard satin anodized finish with clear anodic coating complying with AA requirements for Class II Architectural Coating (AA-A31).

Chalktrough: Furnish continuous aluminum chalktroughs for each chalkboard, unless otherwise indicated, as follows.

Solid Extrusion, manufacturer's standard ribbed section, with exposed ends smoothly curved.

Map Rail: Furnish map rail at the top of each unit, unless otherwise indicated, with the following accessories for each map rail.

Display Rail: Continuous cork approximately 12" high, integral with map rail. See drawings for limits of rail.

Map Hooks: Provide 2 map hooks for each 4' of map rail or fraction thereof.

FABRICATION:

Assembly: Provide factory assembled Markerboard and tackboard units.

Make joints only where the total length exceeds the maximum manufactured length. Fabricate with the minimum number of joints, balanced around the center of the board, as acceptable to the Architect.

Provide the manufacturer's standard vertical joint system between abutting sections of Markerboard.

Provide mullion trim at joints between chalkboard and tackboard.

PART 3 - EXECUTION

PREPARATION:

Field Measurements: Take field measurements prior to the preparation of shop drawings and fabrication where possible, to ensure proper fitting of the work. However, allow for trimming and fitting wherever taking of field measurements before fabrication might delay work.

INSTALLATION:

Deliver factory-built chalkboard and tackboard units completely assembled in one piece without joints, wherever possible. Where dimensions exceed panel size, provide 2 or more pieces of equal length as acceptable to the Architect.
When overall dimensions require delivery in separate units, pre-fit components at the factory, disassemble for delivery, and make final joints at the site. Use splines at joints to maintain surface alignment.

Install units in locations and at mounting heights indicated on drawings and in accordance with the manufacturer's instructions. Keep perimeter lines straight, plumb and level. Provide all grounds, clips, backing materials, brackets, anchors, trim and accessories necessary for a complete installation.

ADJUST AND CLEAN:

Verify that accessories required for each unit have been properly installed and that operating units function properly.

Clean units in accordance with the manufacturer's instructions.

Break-in chalkboards only as recommended by the manufacturer.

END OF SECTION 10100

SECTION 10260 - CLEAR CORNER GUARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Corner guard system for wall protection at ALL exposed Drywall corners.

1.02 SECTION INCLUDES

A. Clear Corner Guards

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM)

B. Underwriters Laboratory (UL)

1.04 SYSTEM DESCRIPTION

A. Performance Requirements: Provide Corner Guard Systems that conform to the following requirements of regulatory agencies and the quality control of IPC Door and Wall Protection Systems, InPro Corporation.

1. Fire Performance Characteristics: Provide clear materials with V2 rating as tested in accordance with UL94.

1.05 SUBMITTALS

A. Product Data: Manufacturer's printed product data for each type of corner guard specified.

B. Detail Drawings: Mounting details with the appropriate adhesives for specific project substrates.

C. Samples: Verification samples of corner guard, 8" (203mm) long, in full size profiles of each type and color indicated.

D. Manufacturer's Installation Instruction: Printed installation instructions for each corner guard.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in unopened factory packaging to the jobsite

B. Inspect materials at delivery to assure that specified products have been received.

C. Store in original packaging in a climate controlled location away from direct sunlight.

1.07 PROJECT CONDITIONS

A. Environmental Requirements: Products must be installed in an interior climate controlled environment.

1.08 WARRANTY

A. Standard IPC Limited Lifetime Warranty against material and manufacturing defects.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Acceptable Manufacturer:

Basis of Design: IPC Door and Wall Protection Systems,
InPro Corporation, PO Box 406 Muskego, WI 53150 USA;
Telephone: 800-222-5556, Fax: 888-715-8407,
Internet address: www.inprocorp.com

B. Substitutions: With prior approval.

C. Provide all corner guards and wall protection from a single source.

2.02 MANUFACTURED UNITS

A. Corner Guard Profile - Standard

1. Clear Corner Guard Options

Size	Thickness	Shape
2 ½" (64mm) x 2 ½" (64mm)	.100" (2.5mm)	90°

8' (2.44m) standard heights

2.03 MATERIALS

A. PC/PETG: Clear corner guards shall be extruded from clear thermoplastic material

2.04 COMPONENTS

A. Fasteners: All mounting system accessories appropriate for substrates indicated on the drawing shall be provided.

B. Adhesive Backed: Provide polycarbonate corner guards with self adhesive backing.

2.05 FINISHES

A. Surface shall be smooth.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions in which the corner guard systems will be installed.

1. Complete all finishing operations, including painting, before beginning installation of corner guard system materials.

B. Wall surface shall be dry and free from dirt, grease and loose paint.

3.02 PREPARATION

A. General: Prior to installation, clean substrate to remove dust, debris and loose particles.

3.03 INSTALLATION

A. General: Locate the corner guard as indicated on the approved detail drawing for the appropriate substrate and in compliance with the IPC installation instructions. Install level and plumb at the height indicated on the drawings.

B. Installation of Clear Corner Guard

1. Screw-on: Apply to corner with self-tapping nail screws for ¾" (19mm) guards and chrome plated screws for 1 ⅛" (29mm) and 2 ½" (64mm) guards that have pre-drilled mounting holes.

3.04 CLEANING

A. At completion of the installation, clean surfaces in accordance with the IPC clean-up and maintenance instructions.

Allows existing wall color or pattern to show through

END OF SECTION

SECTION 10350 - FLAGPOLES

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Provide (2) 30' aluminum flagpoles.
Provide (1) United States Flag – 5'-0" x 8'-0"
Provide (1) Texas Flag – 5'-0" x 8'-0"

Extent and location of each type of flagpole shown on drawings.

QUALITY ASSURANCE:

Manufacturing Standards: Provide each flagpole as a complete unit produced by a single manufacturer, including fittings accessories, bases and anchorage devices.

Design Criteria: Provide flagpoles and installations constructed to withstand a 90 mph wind velocity when flying flag of appropriate size. Use heavy pipe sizes if required for flagpole type and height shown.

Pole Construction: Construct pole and ship to site in one piece if possible. If more than one piece is necessary, provide snug-fitting, precision joints with self-aligning, internal splicing sleeve arrangement for weather-tight, hairline field joints.

SUBMITTALS:

Product Data: Submit manufacturer's technical data and installation instructions for each type of flagpole required.

Shop Drawings: Submit shop drawings of flagpoles and bases, showing general layout, jointing and complete anchoring and supporting systems.

DELIVERY, STORAGE AND HANDLING:

Spiral wrap flagpoles with heavy Kraft paper or other protective wrapping and prepare for shipment in hard fiber tube or other protective container.

Deliver flagpole and accessories completely identified for installation procedure. Handle and store flagpoles to prevent damage or soiling.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS:

Manufacturer: Subject to compliance with requirements, provide products of one of the following:

Acme Flagpole Div., Lingo Inc.

American Flagpole, Div. of Kearney-National, Inc.
Concord Industries, Inc.
Eagle Mountain Flag & Flagpole Co.
Eder Flag Mfg. Co.
Morgan and Co.

FLAGPOLE TYPE:

Aluminum Flagpoles: Fabricate aluminum flagpoles from seamless extruded tubing, complying with ASTM B 241, alloy 6063-T6, having a minimum wall thickness of 3/16" (0.1875").

Provide continuous tapered aluminum flagpoles.

FLAGPOLE MOUNTING:

Provide manufacturer's standard base system for the type of flagpole installation required.

Base Plate: For anchor-bolt mounting, furnish manufacturer's standard cast metal shoe base of same material as flagpole. Furnish and install anchor bolts and lighting ground spike as required.

Foundation Tube: For ground-set flagpoles, proved 16-gage minimum galvanized corrugated steel tube, or 12 gage rolled steel tube, sized to suit flagpole and installation. Furnish complete with welded steel bottom base and support plate, lightning ground spike, and steel centering wedges, all welded construction. Provide loose hardwood wedges at top for plumbing pole after erection. Galvanize steel parts after assembly, including foundation tube.

Provide steel ground protector extending 12" above ground and 6" below ground for steel flagpoles where base or flash collars are not provided.

SHAFT FINISH:

Aluminum: Fine directional, mechanical satin polish (NAAMM-32), finished as follows:

Anodized Aluminum

FITTINGS:

Aluminum Ball: Manufacturer's standard flush seam ball, 6" as indicated, or if not indicated, to match pole butt diameter.

14 ga. spun aluminum, finished to match pole shaft.

Truck: Ball-bearing non-fouling, revolving, double-track assembly of cast metal, finished to match pole shaft.

Cleats: Two 9" cast metal cleats with fasteners, finished to match pole shaft.

Halyards: Provide 2 continuous halyards for each flagpole, as follows:
Polypropylene, white, braided.

Size: 3/8" (No. 12)

Halyard Flag Snaps: Provide 2 swivel snaps per halyard.

FLAGS:
Made of extra tough poly – woven of two-ply polyester yarn.
Provide (1) United States Flag – 5'-0" x 8'-0"
Provide (1) Texas Flag – 5'-0" x 8'-0"

PART 3 - EXECUTION

INSTALLATION:

Excavation: Excavate for foundation concrete to neat clean lines in undisturbed soil.. Provide forms where require due to unstable soil conditions. Remove wood, loose soil, rubbish and other foreign matter from excavation, and moisten the earth before placing concrete.

Concrete: Provide concrete composed of portland cement, coarse aggregate, fine aggregate and water, mixed in proportions to attain 28-day compressive strength of not less than 3000 psi. Use not less than 5 sacks of portland cement, complying with ASTM C 150, per cubic yard of wet concrete.

Plase concrete immediately after mixing. Perform chuting to avoid segregation of mix. Compact concrete in place by use of vibrators to consolidate. Moist-cure exposed concrete for not less than 7 days, or use a non-staining curing compound in freezing weather.

Finish trowel exposed concrete surfaces to smooth, dense surface.
Provide positive slope for water runoff to base perimeter

Flagpole Installation: Install flagpoles as shown and in compliance with final shop drawings and manufacturer's instructions.

Provide positive lightning ground for each flagpole installation.

END OF SECTION 10350

SECTION 10440 SPECIALTY SIGNS

PART 1 GENERAL

RELATED DOCUMENTS:
Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work specified in this section.

DESCRIPTION OF WORK:
Extent of specialty signs is shown on drawings.

Forms of specialty signs required include the following:
- Panel signs
- Metal letters
- Illuminated Channel Letters – Direct Mount
- Cast metal plaques
- Metal signs

QUALITY ASSURANCE:
Uniformity of Manufacturer: For each sign form and graphic image process indicated, furnish products of a single manufacturer.

SUBMITTALS:
Product Data: Submit manufacturer's technical data and installation instructions for each type of sign required.

Samples: Submit samples of each sign form and material showing finishes, colors, surface textures and qualities of manufacture and design of each sign component, including graphics.

Shop Drawings: Submit shop drawings for fabrication and erection of specialty signs. Include plans, elevations, and large scale details of sign wording and lettering layout. Show anchorages and accessory items. Furnish location template drawings for items supported or anchored to permanent construction.

Furnish full size rubbings for metal plaques.

PART 2 PRODUCTS

ACCEPTABLE MANUFACTURERS:
Panel Signage

Manufacturers of Rooms Signs:
Basis of Design: Corpus Christi Stamp Works
Bayuk Graphic Systems, Inc.
MULTI-graphics, Inc.

Manufacturers of Metal Letters
Basis of Design: A.R.K. Ramos
Gemini Sign Products

Manufacturers of Plaques
Basis of Design: A.R.K. Ramos
The Southwell Company.

Manufacturers of Illuminated Channel Letters
Basis of Design: Signs & More
2108 Central Boulevard, Brownsville, TX 78520

MATERIALS:
Plastic Laminate: Provide high pressure plastic laminate engraving stock with face and core plies in contrasting colors, in finishes and color combinations indicated or, if not indicated, as selected from the manufacturer's standard.

FABRICATION OF PANEL SIGNS::
Fabricate panels signs to comply with the requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes and details of construction. Provide and install, one per door.

Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed condition within a tolerance of plus or minus 1/16" measured diagonally from corner to corner.

Framed Panel Signs: Fabricate unframed panel signs with edges mechanically and smoothly finished to conform to following requirements:

A. Character Proportion. Letters and numbers on signs should have a width to height ratio between 3:5 and 1:1 and a stroke width to height ratio between 1:5 to 1:10 utilizing an uppercase "X" for measurement.

B. Color Contrast. Characters and symbols shall contrast with their background.

C. Tactile Characters and Symbols. Characters, symbols, or pictographs on signs required to be tactile, shall be raised 1/32 inch minimum. Letters and numbers refer to plans for text height at specific locations. Font shall be: Proxima Nova

D. Sign Types – Refer to Plans for all room types and sizes
Name Slot at all Office Locations
Room Signs, Typical
Stair Identification
Restroom Signs
Dress Room Signs

ILLUMINATED CHANNEL LETTERS:
General: Provide Illuminated Channel Letters – Direct mount letters to comply with requirements indicated for manufacturing process, materials, finish, style, size and message content.

Illuminated Channel Letters (Front): Acrylic
Letter Returns: Aluminum (Black with White Interior Finish)
Bulb Type: 6500K LED’s
11’-3” Tall - IDEA LIGHTBULB LOGO (Yellow Bulb with White screw threads)
36” Tall – IDEA – (Color White – Font: Myriad Pro Black)
12” Tall - Public Schools (Color White – Font: Myriad Pro Black)
Refer to drawings for location and spacing. Coordinate power supply with Electrical drawings.

METAL LETTERS AND NUMBERS:
General: Provide metal letters and numbers to comply with requirements indicated for manufacturing process, materials, finish, style, size and message content.

Cast letters and numbers: Form letters and numbers by casting. Produce characters with smooth, flat faces; sharp corners; precisely formed lines and profiles; and free from pits, scale, sand holes or other defects. Cast lugs into back of characters and tap to receive threaded mounting studs.

METAL: Aluminum – Clear Anodized
3’-10” Tall - IDEA LIGHTBULB LOGO
10” Tall – IDEA (Font: Myriad Pro Black)
3” Tall - Public Schools (Font: Myriad Pro Black)
6” Tall – BROWNSVILLE ROBINDALE (Font: Poxima Nova Black)

Refer to drawings for location and spacing. Coordinate substrate anchoring with General Contractor

CAST METAL PLAQUES:
Fabricate cast plaques to comply with requirements indicated below for metal, border style, background texture and finish, and on drawings for thickness, size, shape and copy. Produce castings free from pits, scale, and sand holes or other defects. Hand tool and buff borders and raised copy to produce manufacturer's standard satin polished finish. Refer to "Finish" article of other finish requirements.

Quantity: One (1)
Size: 30”W x 20”H x 3/4” D (with IDEA Public Schools Logo)
Metal: Bronze.
Fonts: Proxima Nova Light, Proxima Nova Extra Bold and Proxima Nova Black (Refer to drawings for plaque layout)
Texture: Letherette
Finish: BR-400 Dark Oxidized background with Satin Bronze raised areas
Mounting: Concealed (Verify location for anchoring type)

METAL SIGN:
General: Provide and install handicap metal signs as per attached drawings.
Provide and install 18" x 24" aluminum signs as per attached drawing.

Materials: Aluminum signs shall be as manufactured by Supersign or equal.

Mounting Pole shall be aluminum .125 wall thickness and five feet in height above finished sidewalk elevation.

FINISHES:
General:

Colors and Surface Textures: For exposed sign materials which require selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide color matches indicated, or if not otherwise indicated,
as selected by the Architect from the manufacturer's standards.

Metal Finishes: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations.

Aluminum Finishes:

Baked Enamel Finish: Provide finish AA M4xC12C42Rlx (manufacturer's standard non directional mechanical finish including sanding and filing; cleaning with inhibited chemicals; conversion coated with an acid chromate fluoride phosphate treatment; and painted with organic coating specified below).

Bronze Finishes:
Natural Satin Finish: NAAMM-M31-06x (fine satin directional textured mechanical finish with clear organic coating specified below).

Clear Organic Coating: Manufacturer's standard clear coating.

PART 3 EXECUTION:
INSTALLATION:
General: Locate sign units and accessories where shown or scheduled, using mounting methods of type described and in compliance with the manufacturer's instructions, unless otherwise indicated.

Install sign units level, plumb and at the height indicated, with sign surfaces free from distortion or other defects of appearance.

Panel Signs:
Wall Mounted Units: Attach panel signs to wall surfaces using the methods indicated below:

Vinyl Tape Mounting (VTM): Use double sided foam tape, or thickness indicated, to mount signs to smooth non porous surfaces. Do not use for vinyl covered or rough surfaces.

Where mounted on glass provide blank sign on inside of glass.

Metal Letters and Numbers:

Mount letters and numbers as follows: use standard fastening methods recommended by manufacturer for letter form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy weight paper template to establish letter spacing and to locate holes for fasteners.

Flush Mounting (FM): Mount letters either backs in contact with wall surface.

Cast Metal Plaques: Mount cast plaques using the manufacturer's standard fastening methods recommended by manufacturer for type of wall surface indicated.

Concealed Mounting: Mount the plaques by inserting threaded studs into tapped lugs on the back of the plaque. Set in predrilled holes filled with quick setting cement.

CLEANING AND PROTECTION:
At completion of the installation, clean soiled sign surface in accordance with the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

END OF SECTION 10440

SECTION 10500 METAL LOCKERS

PART 1 GENERAL

RELATED DOCUMENTS
Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

SUMMARY

This Section includes metal lockers and related equipment as indicated on drawings.

Types of products in this section include the following:

Double Stack Lockers with Slope Top.
Five Stack Lockers with Slope Top

Concrete base for lockers is specific in Division 3.

QUALITY ASSURANCE

Uniformity: Provide metal lockers that are standard products of single manufacturer, with interchangeable like parts. Include necessary mounting accessories, fittings, and fastenings.

SUBMITTALS
Submit the following in accordance with Conditions of Contract and Division Specification sections.

Product data and installation instructions for metal locker units.

Color Samples on squares of same metal to be used for fabrication of lockers.

Shop Drawings that show metal lockers in dimensioned relation to adjacent surfaces. Show lockers in detail, method of installation, fillers, trim, base, and accessories. Include locker numbering sequence information.

Combination Listing for combination locks and their respective locker numbers. Coordinate with shop drawings submittal, if required.

JOB CONDITIONS
Do not deliver metal lockers until building is enclosed and ready for locker installation. Protect from damage during delivery, handling, storage, and installation.

PART 2 PRODUCTS

MANUFACTURERS

Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include the following:

Medart.
Lyon
Republic Steel Corp., Industrial Products Div.

MATERIALS

Sheet Steel: Mild cold rolled and leveled furniture steel, free from buckle, scale, and surface imperfections.

Fasteners: Cadmium, zinc, or nickel plated steel; exposed bolt heads, slot-less type; self locking nuts or lock washers for nuts on moving parts.

Equipment: Hooks and hang rods of cadmium plated or zinc plated steel.

FABRICATION, GENERAL

Construction: Fabricate lockers square, rigid, and without warp, with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch. Weld frame members together to form rigid, one piece structure. Weld, bolt, or rivet other joints and connections. Grind exposed welds flush. Do not expose bolts or rivet heads on fronts of locker doors or frames.

Frames: Fabricate of 16 gage channels or 12 gage angles, minimum, with continuous stop/strike formed on vertical members.

Finishing: Chemically pre-treat metal with degreasing and phosphatizing process. Apply baked on enamel finish to all surfaces, exposed and concealed, except plates and nonferrous metal.

Color: Provide locker units in color(s) selected by Architect from manufacturer's standards. Unless otherwise indicated, concealed parts may be manufacturer's standard neutral color. A maximum of (2) colors will be selected.

LOCKERS

Equal to Republic Heavy Duty Ventilated at Gymnasium Lockerrooms.
Equal to Republic Standard Lockers at Kitchen.

Body: Fabricate back and sides of minimum 24 gage steel, with double flanged connections extending full height. Form top and bottom of not less than 24 gage steel, with flanged edges.

Gym Locker Unit Size 12" X 12" X 36 – Double Tiered.
Kitchen Locker Unit Size 12” x 15” x 24” – Five Tiered

Provide slope top at all lockers

Door: One piece, minimum 16 gage sheet steel, flanged at all edges, constructed to prevent springing when opening or closing. Fabricate to swing 180 degrees.

Reinforcing: Provide extra bracing or reinforcing on inside of doors over 15 inches wide.

Ventilation: Provide stamped, louvered vents in door face, as follows:

Hinges: Heavy duty, not less than 0.050" thick steel, full loop, 5 knuckle, tight pin, 2" high. Weld to inside of frame and secure to door with not fewer than 2 factory installed fasteners that are completely concealed and tamperproof when door is closed.

Provide at least 3 hinges for each door over 42 inches high; at least 2 hinges for each

door 42 inches.

Locking Device: Shall be a positive automatic type locking device of the pre-locking type, on all single tier and double tier lockers, whereby locker may be locked while door is open, then closed without unlocking and without damaging locking mechanism. The silencers on the frame hooks shall be securely attached. Lock bar shall be of double channel formation and tamperproof. All handle parts, including fixed case and lifting trigger to be attached to the door with two hex washer heads, thread rolling screws and shock absorbing stud. The case fully shields the lifting trigger from below. the lifting trigger to have two right angle lugs that insert into the lock bar without the use of a fastening device. The lifting trigger is to be equipped with rubber silencers at top and bottom to prevent metal to metal contact. Padlock attachment with 3/8" diameter hole positioned so that the fixed handle case provides a padlock strike. The handle design must be free to openings or surfaces that permit leverage to be applied that forces the handle upward when in a locked position. There shall be three locking points on single tier lockers, and two locking points on double tier lockers. Triple tier and box lockers shall not have pre locking device, lockbar and handle.

Latching Standard: Shall be a one piece, self contained spring steel latch, so designed as to be easily removable from the lock bar for replacement, but completely contained with the lock bar without the use of additional fasteners and is under tension to provide rattle free operation. The lock bar shall be of double channel construction providing maximum strength, as to hold the latch within the door channel at proper operating location. The lock bar shall be held laterally in the door channel by means of non removable self formed retainers, pierced from the door and held in place vertically by the lock bar handle lugs. Rubber silencers and provided at the securely attached to each frame hook on the door jamb.

LOCKER ACCESSORIES

Built In Combination Lock: Key controlled, 3 number dialing combination lock, with combination change made automatically by use of control key.

Multi Tier Lockers: Provide #1654 Master Spring Bolt Lock.

Equipment: Furnish each locker with the following items, unless otherwise shown:

Double & Triple-Tier Units: One double-prong hook ceiling hook and not less than 2 single-prong wall hooks.

Number Plates: Manufacturer's standard etched, embossed, or stamped, nonferrous metal number plates with numerals not less than 3/8 inches high. Number lockers in sequence as directed by Architect. Attach plates to each locker door, near top, centered, with at least 2 fasteners of same finish as number plate.

Separators: Provide horizontal dividers of not less than 16 gage sheet steel between doors of multiple tier lockers to ensure rigidity.

Filler Panels: Provide filler panels where indicated, of not less than 16 gage steel sheet, factory fabricated and finished to match locker units.

PART 3 EXECUTION

PREPARATION:

Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication of special components, when possible, to ensure proper fitting of work. However, allow for adjustment and fitting of trim and filler panels wherever taking of field measurements before fabrication might delay work.

INSTALLATION

Install metal lockers at locations shown in accordance with manufacturer's instructions for plumb, level, rigid, and flush installation.

Space fastenings about 48 inches o.c., unless otherwise recommended by manufacturer, and apply through backup reinforcing plates where necessary to avoid metal distortion, using concealed fasteners.

Install trim, and metal filler panels where indicated, using concealed fasteners. Provide flush, hairline joints against adjacent surfaces.

ADJUST AND CLEAN

Adjust doors and latches to operate easily without binding. Verify that integral locking devices are operating properly.

Touch up marred finishes, but replace units that cannot be restored to factory finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10500

SECTION 10520 - FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:
Definition: "Fire extinguishers" as used in this section refers to units which can be hand carried, unless otherwise specified.

Types of products required include:
Fire extinguishers.
Fire extinguisher cabinets.

QUALITY ASSURANCE:
Provide portable fire extinguishers, cabinets and accessories by one manufacturer, unless otherwise acceptable to Architect.

SUBMITTALS:
Product Data: Submit manufacturer's technical data and installation instructions for all portable fire extinguishers required. Where color selections by Architect are required include color charts showing full range of manufacturer's standard colors and designs available.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS:
J. L. Industries.
Larsen's Mfg. Co.

FIRE EXTINGUISHERS:
General: Provide fire extinguishers for each extinguisher cabinet and other locations indicated, in colors and finishes selected by Architect from manufacturer's standard which comply with requirements of governing authority.

Fill and service extinguishers to comply with requirements of governing authorities and manufacturer's requirement.

Multi Purpose Dry Chemical Type: UL rated 4 A: 60 BC, 10 lb. nominal capacity, in enameled steel container for Class A, Class B and Class C fires.

Type K Extinguishers will be required at Snack Bar, Serving Line and Kitchen locations.

FIRE EXTINGUISHER CABINETS:
General: Provide fire extinguisher cabinets (FECB) where indicated, of suitable size for housing fire extinguishers of types and capacities indicated.

Construction: Manufacturer's standard enameled steel box, with trim, frame, door and hardware to suit cabinet type, trim style, and door style indicated. Weld all joints and grind smooth. Miter and weld perimeter door frames.

Cabinet Type: Suitable for mounting conditions indicated, of the following types:

Semi Recessed: Cabinet box (tub) fully recessed in walls of sufficient depth to suit style of trim indicated.

Trim Style: Fabricate trim in one piece with corners mitered, welded and ground smooth.
Exposed Trim: One piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
Rolled Edge Trim: Rounded edges with backbend depth as follows:
Depth: 2 1/2".
Trim Metal: of same metal as door.

Door Material and Construction: Manufacturer's standard door construction, of material indicated, coordinated with cabinet types and trim styles selected.

Door Style: Equal to JL Vertical Duo

Duo Panel: Tempered glass, 1/8" thick, unless otherwise indicated.

Additional Features: Red Vertical FE letters

Door Hardware: Provide manufacturer’s standard door operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam action latch, or door pull, exposed or concealed, and friction latch. Provide concealed or continuous type hinge permitting door to open 180 degrees.
FACTORY FINISHING OF FIRE EXTINGUISHER CABINETS
General: Comply with NAAMM “Metal Finishes Manual" for finish designations and application recommendations except as otherwise indicated. Apply finishes in factory after products are assembled. Protect cabinets with plastic or paper covering, prior to shipment.

Aluminum Finishes:
Provide #180 clear anodized door and frame.

PART 3 - EXECUTION

INSTALLATION:
Install items included in this section in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.

Prepare recesses in walls for fire extinguisher cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.

Where exact location of bracket mounted fire extinguishers is not indicated, locate as directed by Architect.

IDENTIFICATION:
Identify existence of fire extinguisher in cabinet with lettering spelling "FIRE EXTINGUISHER” painted on door by silk screen process. Provide lettering on door as indicated, or if not indicated, as selected by Architect from Manufacturer's standard letter sizes, styles, colors and layouts.

END OF SECTION 10520

SECTION 10650 OPERABLE PARTITIONS

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. Manually operated, paired panel operable partitions.
B. Related Sections include the following:
    1. Division 3 Sections for concrete tolerances required.
    2. Division 5 Sections for primary structural support, including pre-punching of support members by structural steel supplier per operable partition supplier's template.
    3. Division 6 Sections for wood framing and supports, and all blocking at head and jambs as required.
    4. Division 9 Sections for wall and ceiling framing at head and jambs.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified in writing by the operable partition manufacturer, as qualified to install the manufacturer's partition systems for work similar in material, design, and extent to that indicated for this Project.
B. Acoustical Performance: Test operable partitions in an independent acoustical laboratory in accordance with ASTM E90 test procedure to attain no less than the STC rating specified. Provide a complete and unedited written test report by the testing laboratory upon request.
C. Preparation of the opening shall conform to the criteria set forth per ASTM E557 "Standard Practice for Architectural Application and Installation of Operable Partitions."

1.4 SUBMITTALS

A. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable partition, component, and accessory specified.
B. Shop Drawings: Show location and extent of operable partitions. Include plans, elevations, sections, details, attachments to other construction, and accessories. Indicate dimensions, weights, conditions at openings, and at storage areas, and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, including floor tolerances required and direction of travel. Indicate blocking to be provided by others.
C. Setting Drawings: Show imbedded items and cutouts required in other work, including support beam punching template.
D. Samples: Color samples demonstrating full range of finishes available by architect. Verification samples will be available in same thickness and material indicated for the work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Clearly mark packages and panels with numbering systems used on Shop Drawings. Do not use permanent markings on panels.

B. Protect panels during delivery, storage, and handling to comply with manufacturer's direction and as required to prevent damage.

1.6 WARRANTY

A. Provide written warranty by manufacturer of operable partitions agreeing to repair or replace any components with manufacturing defects.
B. Warranty period: Two (2) years.

PART 2 – PRODUCTS

2.1 MANUFACTURERS, PRODUCTS, AND OPERATION

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
    1. Basis of Design: Moderco
       Modernfold, Inc.

B. Products: Subject to compliance with the requirements, provide the following product:
    1. Basis of Design: Moderco Model 8500
    2. Modernfold: Acousti-Seal #932 manually operated paired panel operable partition.

2.2 OPERATION

A. Moderco Model 8500: Series of paired flat panels hinged together in pairs, manually operated, top supported with operable floor seals.
B. Final Closure
    1. Hinged panel closure

2.3 PANEL CONSTRUCTION

A. Nominal 3-inch (76mm) thick panels in manufacturer's standard 48-inch (1220mm) widths. All panel horizontal and vertical framing members fabricated from minimum 18-gage formed steel with overlapped and welded corners for rigidity. Top channel is reinforced to support suspension system components. Frame is designed so that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin.
B. Panel Skin Options:
    1. Roll-formed steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings of panels with this construction (select one):
        a. 52 STC
C. Hinges for Panels, Closure Panels, Pass Doors, and Pocket Doors shall be:
    1. Full leaf butt hinges, attached directly to panel frame with welded hinge anchor plates within panel to further support hinge mounting to frame. Lifetime warranty on hinges. Hinges mounted into panel edge or vertical astragal are not acceptable.
D. Panel Trim: No vertical trim required or allowed on edges of panels; minimal groove appearance at panel joints.
E. Panel Weights:
    Steel Skin: 52 STC – 11 lbs./square foot
F. Panel Width: Adjust panel widths to conform with pocket size noted on documents.

2.4 PANEL FINISHES

A. Panel face at Door 26 (Classrooms) shall be:
1. Acoustical, non-woven needle punch carpet, with fused fibers to prevent unraveling or fray of material.
Panel Trim: Exposed panel trim of one consistent color.

B. Panel face at Door 27 (Cafeteria) shall be:
1. Reinforced vinyl with woven backing weighing not less than 21 ounces per lineal yard.
Panel Trim: Exposed panel trim of one consistent color.

2.5 SOUND SEALS

A. Vertical Interlocking Sound Seals between panels: Roll-formed steel astragals, with reversible tongue and groove configuration in each panel edge for universal panel operation. Rigid plastic astragals or astragals in only one panel edge are not acceptable.
B. Horizontal Top Seals: Continuous contact extruded vinyl bulb shape with pairs of non-contacting vinyl fingers to prevent distortion without the need for mechanically operated parts.
C. Horizontal Bottom Seals:
1. Moderco Model 8500: Manually activated bottom seals with self-contained handle providing nominal 2-inch (51mm) operating clearance with an operating range of +1/2-inch (13mm) to –1-1/2-inch (38mm). Seal shall be operable from panel edge or face.

2.6 SUSPENSION SYSTEM

A. #14 Suspension System
1. Suspension Tracks: Minimum 7-gage, 0.18-inch (4.57mm) roll formed steel. Static loading of track with brackets at 48-inch (1220mm) centers shall show no failure of track or brackets at 5,000 pounds (2550kg) point loading at midspan. Track shall be supported by adjustable steel hanger brackets connected to structural support pairs of 1/2-inch (13mm) diameter threaded rods. Brackets must support the load bearing surface of the track.
a. Exposed track soffit: Steel, removable for service and maintenance, attached to track bracket without exposed fasteners, and prepainted off-white.
2. Carriers: One all steel trolley with steel-tired ball bearing wheels per panel (except hinged panels). Non-steel tires are not acceptable.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General: Comply with ASTM E557, operable partition manufacturer’s written installation instructions, Drawings and approved Shop Drawings.
B. Install operable partitions and accessories after other finishing operations, including painting have been completed.
C. Match operable partitions by installing panels from marked packages in numbered sequence indicated on Shop Drawings.
D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

3.2 CLEANING AND PROTECTION

A. Clean partition surfaces upon completing installation of operable partitions to remove dust, dirt, adhesives, and other foreign materials according to manufacturer's written instructions.
B. Provide final protection and maintain conditions in a manner acceptable to the manufacturer and Installer that insure operable partitions are without damage or deterioration at time of Substantial Completion.

3.3 ADJUSTING

A. Adjust operable partitions to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and other moving parts.

3.4 EXAMINATION

A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable partitions. Proceed with installation only after unsatisfactory conditions have been corrected.

3.5 DEMONSTRATION

A. Demonstrate proper operation and maintenance procedures to Owner's representative.
B. Provide Operation and Maintenance Manual to Owner's representative.

END OF SECTION 10650

SECTION 10730 – DOOR AND WINDOW ALUMINUM CANOPIES

1.0 **PART 1 – GENERAL**

1.1 DESCRIPTION OF WORK

1.1.A Furnish and install custom aluminum Door and Window Canopies as shown on drawings and specifications.

1.1.B The architectural drawings show the general dimensions and profile of the Protective Covers.

1.2 SUBMITTALS

1.2.A Submit product specifications and installation instructions from the manufacturer of the Canopies.

1.2.B Submit shop drawings for approval by architect prior to fabrication of Canopies.

1.2.C The shop drawings shall include plans, elevations, sections, and details showing profiles, angles, and spacing of the blades, the sun cutoff angle, and spacing of the frame supports. Indicate anchorage details and locations.

1.2.D Submit two finished samples of each of the materials to be used in each Canopy.

1.2.E Provide written warranty to the owner that all Canopies will be free of defective materials and workmanship for a period of one year from the date of installation.

1.3 QUALITY ASSURANCE

1.3.A Single subcontract responsibility: Subcontract the work to a single firm that has had no less than five (5) years of experience in the design and manufacturing of the work specified.

1.3.B Performance requirements: Design Canopies according to local building code and requirements for snow and wind loading. Provide signed and sealed engineering drawings by a Professional Engineer registered in the sate where the project is located.

1.3.C Door Canopies shall be installed by manufacturer. Outsourcing installation to a third party subcontractor is not acceptable.

1.3.D Canopy systems, including material and workmanship, shall be warranted from defects for a period of one year from substantial completion of installation.

1.4 POJECT CONDITIONS

1.4.A Ensure fit by performing field measurements before fabrication. Shop drawings will record the actual measurements.
1.4.B Coordinate fabrication schedule with general contractor to avoid constructions delays.

2.0 **PART 2 – PRODUCT**

2.1 Manufacturer:

Bowman Distributing Company
2100 J B Drive
San Benito, TX 78586
Ph. 956-361-5200
Fax. 956-361-5204

2.2 MATERIALS

2.2.A Columns, decking, fascia and beams fabricated from extruded aluminum ASTM B221, Alloy 6063, 6061 or 6005 – T6 temper.
2.2.B Roll-formed deck is not acceptable.
2.2.C Fasteners shall be aluminum or 300 series stainless steel.
2.2.D Anchors and inserts shall be of non-ferrous metal or hot dip galvanized steel as required for corrosion resistance. Use stainless steel or lead expansion bolt devices for drill-in place anchors.
2.2.E Decking shall be 0.080" extruded aluminum interlocking bottom and top
2.2.F Fascia shall be a minimum of .080 in. wall thickness

2.3 FABRICATION

2.3.A Preassemble Canopy assemblies in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations.
2.3.B Include supports, anchorage, fasteners, and accessories required for complete assembly
2.3.C Provide an all welded extruded aluminum system, complete with concealed drainage. Non-welded systems are unacceptable.

2.4 FINISH

2.4.A Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated.
2.4.B Protect finish on exposed surfaces prior to shipping.

2.4.C Anodize finish:

Clear: AA-M12C22A31, 215-R1, Architectural Class I
Color: AA-M12C22A31, light bronze, medium bronze, dark bronze, and black, Architectural Class I.
Clear: AA-M12C22A41, 204-R1, Architectural ClassII
Color: AA-M12C22A41, light bronze, medium bronze, dark bronze, and black, Architectural Class II.

2.5 INSTALLATION

2.5.A Install according to manufacturers instructions and recommendations.
2.5.B Verify dimension of supporting structure at the
2.5.C Anchor Canopies to building as indicated in Architectural drawings and shop drawings.
2.5.D Install units plumb and level.
2.5.E Use concealed anchors where possible.
2.5.F Form closely fitted joints with exposed connections accurately located and secured.

2.6 CLEANING AND PROTECTING

2.6.A Clean exposed surfaces of Canopies to remove soil and fingerprints resulting from installation process.
2.6.B Clean with water and a mild dishwashing soap not harmful to finishes. Rinse thoroughly and dry.
2.6.C Clean and touch up minor abrasions in finish with air-dried coating that matches color and gloss of the factory applied finish coating.

SECTION 10800 TOILET ACCESSORIES

PART 1 GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Extent of each type of toilet accessory is indicated on drawings and schedules.

Types of toilet accessories required include the following:

Sanitary napkin disposal units.
Grab bars.
Mirrors.

QUALITY ASSURANCE:
Inserts and Anchorages: Furnish inserts and anchoring devices which must be set in concrete or built into masonry; coordinate delivery with other work to avoid delay.

Accessory Locations: Coordinate accessory locations with other work to avoid interference and to assure proper operation and servicing of accessory units.

Products: Provide products of same manufacturer for each type of accessory unit and for units exposed in same areas, unless otherwise acceptable to Architect.

SUBMITTALS:
Product Data: Submit manufacturer's technical data and installation instructions for each toilet accessory.

Setting Drawings: Provide setting drawings, templates, instructions, and directions for installation of anchorage devices in other work.

PART 2 PRODUCTS:

ACCEPTABLE MANUFACTURERS:
Bobrick Washroom Equipment, Inc.
Bradley Corporation

MATERIALS, GENERAL:
Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 22 gage minimum, unless otherwise indicated.

Mirror Glass: FS DD G 451, Type I, Class 1, Quality q2, 1/4" thick, with silver coating, copper protective coating, and non metallic paint coating complying with FS DD M 411.
Galvanized Steel Mounting Devices: ASTM A 386, hot dip galvanized after fabrication.

Fasteners: Screws, bolts, and other devices of same material as accessory unit or of galvanized steel where concealed.

FABRICATION:
General: Stamped names or labels on exposed faces of toilet accessory units are not permitted, except where otherwise indicated; unobtrusive labels on surfaces not exposed to view are acceptable. Where locks are required for a particular type of toilet accessory, provide same keying throughout project. Furnish two keys for each lock.

Surface Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage wherever possible.

- **Handicap Mirror**: Equal to Bobrick model no. B-165 - 2448, Framed Mirror. Provide one unit at each handicap lavatory. See plans for locations.
- **Hand Dryer**: Hot Air Dryer (see MEP).
- **Grab Bar**: Equal to Bobrick model no. B-6806 series x 42" long, provide at each handicap water closet location.
- **Grab Bar**; Equal to Bobrick model no. B-6806 series x 36" long**,** provide at each handicap water closet location.
- **Mop & Broom Holder:** Equal to Bobrick model no. B-223X36, provide one unit at each janitorial room.
- **Partition Mounted Napkin Dispenser**: Equal to Bobrick model no. B-354
- **Wall Mounted Napkin Dispenser**: Equal to Bobrick model no. B-353
- **Soap Dispenser:** (By Owner)
- **Toilet Paper Dispenser**: (By Owner)
- **Paper Towel Dispenser** (By Owner)
- **Towel Bar 18":** Equal to Bobrick model no. B-530. See plans for locations.
- **Vinyl Shower Curtains:** Equal to Bobrick model no. 204-3. See plans for locations.
- **Shower Rod 60":** Equal to Bobrick model no. B-6047. See Plans for locations.
- **Shower Hooks:** Equal to Bobrick model no. B204-1. See plans for locations.
- **Recessed Soap Dish:** Equal to Bobrick model no. B-4380. See plans for locations.
- **Continuous Grab Bar (Shower) –** 30" x 60" x 30"**,** 1-1/2" O.D. G.B, peened, with snap on flanges**.** (Field Verify Dimensions)

PART 3 - EXECUTION

INSTALLATION:
Install toilet accessory units in accordance with manufacturers' instructions, using fasteners which are appropriate to substrate and recommended by manufacturer of unit. Install units plumb and level, firmly anchored in locations and at heights indicated. General Contractor to provide for solid 2x wood blocking at toilet accessories mounted at gypsum drywall partitons.

ADJUSTING AND CLEANING:
Adjust toilet accessories for proper operation and verify that mechanisms function smoothly.

Clean and polish all exposed surfaces after removing protective coatings.

END OF SECTION 10800

SECTION 11131- PROJECTION SCREENS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Projection Screens required for this work are scheduled on the Plans.
All other screens are to be included in the Contractors base bid.

QUALITY ASSURANCE:

For installation use only personnel who are skilled in the work required.

SUBMITTALS:

Installation Methods: Submit two copies of manufacturer's recommended installation method showing all requirements for blocking and backing.

PRODUCT HANDLING:

Protection:

Project Projection Screens before, during and after installation.

Protect installed work of other trades.

Replacement: In event of damage, make necessary replacements.

PROJECTION SCREENS:

Model: “Professional Electrol”. By Dal-Lite Screen Company

Type: Electrically operated, retractable, large size projection screen with rigid metal roller housing motor; Professional Electrol Screen as manufactured by Da-Lite Screen Company, Inc.

Size: 106" x 188" to be located in the Gymnasium.
92” x 164” to be located in the Cafeteria.

Other Acceptable Manufacturers:	Draper	equal model type
	Polyvision	equal model type
	Platinum Visual System	equal model type

PART 3 - EXECUTION

Surface Conditions:

Inspection:
Inspect installed work of other trades and verify that such work is complete to point

where this work may commence.

Verify that installation may be made in accordance with approved manufacturer's instructions.

Discrepancies:
In event of discrepancy, notify Architect.

Do not proceed with installation until discrepancies have been resolved.

Installation:
Install where indicated, anchoring all components firmly in place in complete accordance with the manufacturer's recommendations.

END OF SECTION 11131

SECTION 11400 - FOOD SERVICE EQUIPMENT

PART 1 GENERAL

SCOPE:
This section includes furnishing all material, labor, equipment and services required to complete food service equipment shown on the drawings and described herein:

RELATED WORK SPECIFIED ELSEWHERE:
Plumbing (refer to Division 15) including:

- Rough In: Piping for supply and waste lines.
- Traps, grease traps, line strainers, tail pieces, valves, stops, shut offs and miscellaneous fittings required for complete installation.
- Final Connections.
- Ventilation (refer to Division 15)
- Roof mounted fans and connecting ductwork not shown as part of the kitchen equipment.

Electrical (refer to Division 16) including:

- Rough in:
- Conduit, wiring, line and disconnect switches, safety cut offs and fittings, control panels, fuses, boxes and fittings required for complete installation.
- Final connections including mounting and wiring of starters and switches furnished as part of the food service equipment (unless otherwise indicated on the drawings).

QUALITY ASSURANCE:
Food Service equipment suppliers shall submit satisfactory evidence of compliance with the following qualifications and conditions to be approved.

Successful completion of jobs of comparable scope.

Have manufacturer's authorization to distribute and install specified factory items of equipment.

Maintain a permanent staff experienced in the installation of food service equipment and preparation of professional style shop drawings and brochures.

Maintain or have access to shop meeting N.S.F. requirements. If other than food service equipment suppliers on shop, obtain approval of shop desired to be used.

Maintain or have access to a readily available stock of repair and replacement parts, together with authorized service personnel.

SUBMITTALS:

Shop Drawings:
Submit to the Consultant for preliminary review within six (6) weeks after notification of award, one sepia and one blue line print of professionally prepared detailed arrangement plans (not traced from the

Contract Documents) and mechanical rough-in plans showing dimensions locations, sizes, elevations and capacities of all services required for each item of equipment.

Submittal shall include bound brochures containing item flysheets, illustrations, specifications, line drawings and rough-in information on all brand name items (items not of his manufacture) herein after specified.

Two (2) preliminary brochures shall be submitted with arrangement plans, rough-in plans and shop drawings as hereinafter specified, for preliminary approval. After approval, drawings and brochures are to be submitted in the number as required by the Architect.

Professionally prepare detailed shop drawings at a minimum scale of 3/4" to the foot, plus necessary cross sections at a scale of 1-1/2" to the foot, showing complete detail of each item of specifically fabricated equipment. These drawings shall be based on the floor plans and the following item specifications.

Drawings shall include accurately dimensions layouts and locations for all masonry bases or recesses if required or called for hereinafter and shall furthermore, if applicable, include accurately dimensions, details and locations of any special wall openings that are required where items of equipment extend through walls.

Do not begin fabrication until shop drawings have been approved.

Food service equipment supplier shall furnish three (3) bound sets of dimensional prints, data sheets, spare parts lists, and operating instructions for each piece of mechanical equipment. These are to be prepared and submitted to Architect before demonstration of equipment (refer to 3.43).

All brochures shall be bound in hard durable covers bearing the job name and date of submission.

PRODUCT DELIVERY, STORAGE AND HANDLING:

Delivery: Equipment shall be delivered only after the building is weather and vandal safe.

Storage: Store equipment in an area convenient to the point of installation in such a way that it can be protected from the weather and job hazards.

Protection: Wrapping and protective coverings shall remain on all items until ready for use and in the case of stainless steel items, until installation is complete and the job is ready for cleaning.

JURISDICTION TRADE AGREEMENTS AND RESTRICTIONS:

Include the work specified, shown or reasonably inferable as part of food service equipment. Portions of this work may be subcontracted to those qualified to do such work, as may be necessary because of jurisdictional trade agreements and restrictions.

REGULATION AND CODES:
In addition to complying with applicable laws, statutes, building codes and regulations of public authorities, comply with the following.

National Sanitation Foundation (to bear label)
National Electric Code
Underwriters' Laboratories, Inc.
American Gas Association Laboratories
National Fire Protection Association
Occupational Safety and Health Act

WARRANTIES:
Warrantee in writing all equipment and fabrication against defects and workmanship for a period of one (1) year from date of acceptance, unless noted otherwise.

KITCHEN EQUIPMENT LIST:

Item No. 1 - TILTING SKILLET BRAISING PAN, ELECTRIC Quantity: Two (2) Total
Vulcan Model No. VE40

- Braising Pan, electric, 40-gallon capacity, 46" wide open base, manual tilt, 9" deep stainless steel pan with gallon markings, pouring lip & removable strainer, spring assist cover with drip edge, pan holder, water tight solid state controls, includes L faucet bracket, 12" stainless steel legs with adjustable flanged feet, UL, cUL, UL EPH
- 1 year limited parts & labor warranty, standard
- 480v/60/3-ph, 16 kW, 23 amps, direct wire
- DBPTYTS WSHDWN DOUBLE Pantry Deck Mount Faucet, with backflow preventer, 16" add-on faucet, washdown hose, wall hook, NSF and Lead Reduction Compliant
- Motor driven pan lift
- BPSTEAM INSERT Steam Pan Insert, for (1) 12" x 20" pan, each - 4 each
- BOILING-BASKET Boiling Basket, 12" x 20" x 6" deep, perforated, stainless steel, with handles - 4 each
- PRE-RINSE FAUCET ASSEMBLY, WITH ADD ON FAUCET Quantity: One (1) Total
  T&S Brass Model No. B-0177 MOD
    - Spray Unit/Swing Spout Faucet, deck mount 8" O.C. type mixing valve, vacuum breaker, hanger hook, 72" stainless steel flexible hose, 1/2" IPS female inlets
    - MODIFY: BASE 002824-40; SPRAY VALVE HEAD B-0107, 064X 16" SWING NOZZLE

Item No. 2 - COMBI OVEN, ELECTRIC Quantity: One (1) Total
Vulcan Model No. ABC7E-480

- Combi Oven/Steamer, electric, boilerless, (7) 18" x 26" full size sheet or (14) 12" x 20" full size hotel pan capacity, LED temperature display, humidity control, multiple cooking modes, timer, auto-reversing fan with electronic braking system, glass door, halogen lights, audible alarm system, (3) knobs, (4) Grab n Go wire racks, stainless steel interior & exterior, NSF/ANSI 4, cULus
- 1 year limited parts & labor warranty, standard
- 480v/60/3-ph, 28.9 amps, 24kW, standard
- Filtration System
- V3MRO-1 Reverse Osmosis Water Filtration System, up to 100 gpd capacity, minimum 60 psi/maximum 125psi, minimum 40°/maximum 100°, Common treatment for sediment, chloramines, chlorine, scale, hardness & TDS reduction, integrated pump & storage tank, includes: steel bracket, wall-mount, quick disconnect plumbing, cleaning bypass assembly, water test strips & connection fittings for Vulcan Combi Oven/Steamers with standard 3/4"

water lines
- ADDRACK-ABC1 Additional Grab n Go Rack wire rack shelf, (1), with cutout design, stainless steel
- STAND-ABC/SS Stand, open frame, stainless steel, with adjustable feet, includes: spray hose & drip tray
- ABC-CAST Casters, with 2 locking wheels, for use only with STAND- ABC/SS
- HOSEWTR 3/4BBV Flex stainless steel water hose 72", 3/4" female NSHT (2 per unit recommended for gas & electric, 1 per unit for direct steam) - 2 each

Item No. 3 - CONVECTION OVEN, ELECTRIC Quantity: Three (3) Total

Vulcan Model No. VC44ED

- Convection Oven, electric, double-deck, standard depth, solid state controls, 60 minute timer, 8" high legs, stainless steel front, top and sides, stainless steel doors with windows, (2) 1/2 HP, 12.5 kW each section, NSF, cUL, UL
- 1 year limited parts & labor warranty, standard 6 ea
- (2) 480v/60/3-ph, 30 amps total, per oven

Item No. 4 - HOT WATER DISPENSER Quantity: One (1) Total

Hatco Model No. AWD-12

- Atmospheric Hot Water Dispenser, countertop design, 12-gallon capacity, automatic fill, pushbutton portion control, low water cut-off, electronic temp. control with digital display, stainless steel tank & base, cULus, UL EPH Classified, ANSI/NSF 4, Made in USA
- NOTE: Sale of this product must comply with Hatco's Minimum Resale Price Policy; consult order acknowledgement for details
- NOTE: Includes 24/7 parts & service assistance, call 800-558-0607
- 208v/60/1-ph, 5.0 kW
- AWD-L6 NEMA L6-30P locking cap in lieu of NEMA 6-30P, (Available at time of purchase only)
- AWD-PLUMB 3 ft. rubber drain hose with 10 ft. 1/4" inlet tubing
- AWD-FILTER Water filtration system with 10' of 1/4" tubing and fittings

Item No. 6 - WORK TABLE, STAINLESS STEEL TOP Quantity: One (1) Total

Advance Tabco Model No. FSS-303

- Work Table, 36"W x 30"D, 14 gauge 304 series stainless steel top with 1-1/2"H rear upturn, 18 gauge stainless steel adjustable undershelf, stainless steel legs & adjustable bullet feet, NSF
- TA-61 Modification to reduce length, start with next largest size then add "TA-61" to model number for tables***table to 30x30 confirm required dims***
- TA-255 Casters, expanding adapter, for 1-5/8" dia. O.D. tube/table legs, 400 lb capacity per caster, set of (4) (2 braked)
- TA-255B Upgrade heavy duty casters (TA-255, TA-256 only) to have brakes on all wheels (upgrade only, must order casters separately)
- TA-366 Reinforced understructure for undershelves (maximum recommended load 30 lbs per sq. ft. evenly distributed weight) (each)
- SS-1520 Deluxe Drawer, 15"W x 20"D x 5" deep drawer pan insert, stainless steel, with drawer slides
- TA-90 Drawer Adapter/Non Catalog Tables, specify table width (pair)

Item No. 7 - MEAT SLICER Quantity: One (1) Total

Hobart Model No. EDGE12-11

- Slicer, manual, med duty, angle feed, 12" carbon steel knife, no volt release, poly-v belt drive, permanent ring guard, removable anodized aluminum carriage & knife cover, top mounted sharpener, anodized aluminum finish, 120v/60/1-ph, 4 amp, 1/2 hp, cETLus, NSF
- Standard warranty - 1-Year parts, labor & travel time during normal working hours within the USA

Item No. 8 - WORK TABLE; STAINLESS STEEL TOP Quantity: One (1) Total

Advance Tabco Model No. FSS-303

- Work Table, 36"W x 30"D, 14 gauge 304 series stainless steel top with 1-1/2"H rear upturn, 18 gauge stainless steel adjustable undershelf, stainless steel legs & adjustable bullet feet, NSF
- TA-61 Modification to reduce length, start with next largest size then add "TA-61" to model number for tables***table to 30x30 confirm required dims***
- TA-255 Casters, expanding adapter, for 1-5/8" dia. O.D. tube/table legs, 400 lb capacity per caster, set of (4) (2 braked)
- TA-255B Upgrade heavy duty casters (TA-255, TA-256 only) to have brakes on all wheels (upgrade only, must order casters separately)
- TA-366 Reinforced understructure for undershelves (maximum recommended load 30 lbs per sq. ft. evenly distributed weight) (each)
- SS-1520 Deluxe Drawer, 15"W x 20"D x 5" deep drawer pan insert, stainless steel, with drawer slides
- TA-90 Drawer Adapter/Non Catalog Tables, specify table width (pair)

Item No. 9 - FOOD PROCESSOR Quantity: One (1) Total

Robot Coupe Model No. CL50E ULTRA

- Commercial Food Processor, includes: vegetable prep attachment with kidney shaped & cylindrical hopper (no bowl), (1) 3mm grating disc (28058), (1) 3mm slicing disc (28064), 2-disc rack, stainless steel motor base, single speed 425 RPM, 1-1/2 HP, 120v/60/1-ph, 12.0 amps, NEMA 5-15P, cETLus, ETL-Sanitation
- 1 year parts & labor warranty

Item No. 10 - TWO (2) COMPARTMENT SINK Quantity: One (1) Total

Advance Tabco Model No. 94-62-36-36RL

- Regaline Sink, 2-compartment, with left & right-hand drainboards, 24" front-to-back x 18"W sink compartment, 14" deep, with 11"H backsplash, stainless steel legs with welded front-to-rear & adjustable left-to-right cross rails, 36" drainboards, 1" adjustable feet, 14 gauge 304 series stainless steel, overall 31" F/B x 113" L/R, NSF
- This sink requires (1) faucet
- K-5 Drain, twist operated, 2" NPT & 1-1/2" IPS outlet connections - 2 each
- K-4 Support Bracket, for lever waste drain handle, (1) support required for each lever drain - 2 each
- K-470 Sink bowl depth modification (14" maximum - specify depth required) (per bowl)
- PRE-RINSE FAUCET ASSEMBLY, WITH ADD ON FAUCET Quantity: One (1) Total
  Fisher Model No. 34460
    - Pre-Rinse Unit, 8" c/c backsplash mount, with spring action flexible gooseneck, wall bracket, Add-On-Faucet with 12" swing spout

- WALL / SPLASH MOUNT FAUCET Quantity: One (1) Total
  Fisher Model No. 46310
  - Faucet, 8" c/c backsplash/wall mount, with 12" swing spout, lever handles, EZ-Install adapters, 1/2" close elbows, stainless steel, NSF

Item No. 11 - THREE (3) COMPARTMENT SINK Quantity: One (1) Total
Advance Tabco Model No. 94-43-72-36RL

- Regaline Sink, 3-compartment, with left & right-hand drainboards, 24" front-to-back x 24"W sink compartments, 14" deep, with 11"H backsplash, stainless steel legs with welded front-to-rear & adjustable left-to-right cross rails, 36" drainboards, 1" adjustable bullet feet, 14 gauge 304 series stainless steel, overall 31" F/B x 151" L/R, NSF (requires 2 faucets)
- K-453 Control Bracket, 14" x 16" (each)
- K-5 Drain, twist operated, 2" NPT & 1-1/2" IPS outlet connections - 3 each
- K-4 Support Bracket, for lever waste drain handle, (1) support required for each lever drain - 3 each
- K-470 Sink bowl depth modification (14" maximum - specify depth required) (per bowl)
- PRE-RINSE FAUCET ASSEMBLY, WITH ADD ON FAUCET Quantity: One (1) Total
  Fisher Model No. 34460
  - Pre-Rinse Unit, 8" c/c backsplash mount, with spring action flexible gooseneck, wall bracket, Add-On-Faucet with 12" swing spout
- WALL / SPLASH MOUNT FAUCET Quantity: One (1) Total
  Fisher Model No. 46310
  - Faucet, 8" c/c backsplash/wall mount, with 12" swing spout, lever handles, EZ-Install adapters, 1/2" close elbows, stainless steel, NSF

Item No. 12 NOT USED

Item No. 13 - ICE CUBER Quantity: One (1) Total
Manitowoc

- Indigo™ Series Ice Maker, cube-style, air-cooled, self-contained condenser, 30"W x 24-1/2"D x 21-1/2"H, production capacity up to 530 lb/24 hours (390 lb AHRI certified 90°/70°), DuraTech™ exterior, dice size cubes, NSF, cULus, ENERGY STAR®
- WARRANTY-ICE-SC 3 year parts & labor (Machine), 5 year parts & labor (Evaporator), 5 year parts (Compressor), standard
- (-161) 115v/60/1-ph, 14.2 amps
- AR-PRE Arctic Pure® Pre-Filter Assembly, 5 micron filtration includes head, shroud, hardware, mounting assembly, & (1) filter cartridge, (NOT stand-alone; should be used in conjunction with primary water filter assembly)
- 1 ea WARRANTY-ARCPURE 3 year parts & labor warranty on cap, housing, hardware, and mounting assembly (does not refer to filter cartridge), standard
- Arctic Pure® Primary Water Filter Assembly, includes head, shroud, hardware, mounting assembly, & (1) filter cartridge, 14,000 gallon capacity, 0-600 lbs./ice per day
- WARRANTY-ARCPURE 3 year parts & labor warranty on cap, housing, hardware, and mounting assembly (does not refer to filter cartridge), standard
- Ice Bin, 48"W x 34"D, 50"H, with top-hinged front-opening door, AHRI certified 710 lb ice storage capacity, for top-mounted ice maker, stainless steel exterior, NSF
- K-00369 Bin Adapter, 30" S or Indigo ice machine to 48" B-970 bin, weight limit 180 lbs. maximum (Series 300, 450 & 500 only)

- WARRANTY-BIN/DISP 3 year parts & labor warranty, standard 1 ea 6" adjustable stainless steel legs, standard

Item No. 14 - WORK TABLE, STAINLESS STEEL TOP Quantity: One (1) Total

Advance Tabco Model No. SS-300

- Work Table, 30"W x 30"D, 14 gauge 304 series stainless steel top, 18 gauge adjustable stainless steel undershelf, stainless steel legs & adjustable bullet feet, NSF
- TA-255 Casters, expanding adapter, for 1-5/8" dia. O.D. tube/table legs, 400 lb capacity per caster, set of (4) (2 braked)
- TA-255B Upgrade heavy duty casters (TA-255, TA-256 only) to have brakes on all wheels (upgrade only, must order casters separately)
- TA-366 Reinforced understructure for undershelves (maximum recommended load 30 lbs per sq. ft. evenly distributed weight) (each)
- TA-94 16 gauge 304 series stainless steel undershelf upgrade (per linear foot)
- SS-1520 Deluxe Drawer, 15"W x 20"D x 5" deep drawer pan insert, stainless steel, with drawer slides
- TA-90 Drawer Adapter/Non Catalog Tables, specify table width (pair)

Item No. 15 - WORK TABLE, STAINLESS STEEL TOP Quantity: One (1) Total

Advance Tabco Model No. FSS-366

- Work Table, 72"W x 36"D, 14 gauge 304 series stainless steel top with 1-1/2"H rear upturn, 18 gauge stainless steel adjustable undershelf, stainless steel legs & adjustable bullet feet, NSF
- TA-366 Reinforced understructure for undershelves (maximum recommended load 30 lbs per sq. ft. evenly distributed weight) (each)
- TA-94 16 gauge 304 series stainless steel undershelf upgrade (per linear foot) - 6 Feet
- SS-1520 Deluxe Drawer, 15"W x 20"D x 5" deep drawer pan insert, stainless steel, with drawer slides - 3 each
- TA-90 Drawer Adapter/Non Catalog Tables, specify table width (pair) 1 ea Rear mount
- TA-229 Rear mounting provision - 3 Pair
- SWT-72 Pot Rack, table mounted, rear or splash mount, semi-circular design, 72" long, stainless steel, includes: (18) plated pot hooks & (1) AUR-72 utensil rack

Item No. 16 - WORK TABLE STAINLESS STEEL TOP Quantity: One (3) Total

Advance Tabco Model No. FSS-366

- Work Table, 72"W x 36"D, 14 gauge 304 series stainless steel top with
- 1-1/2"H rear upturn, 18 gauge stainless steel adjustable undershelf, stainless steel legs & adjustable bullet feet, NSF
- TA-366 Reinforced understructure for undershelves (maximum recommended load 30 lbs per sq. ft. evenly distributed weight) (each)
- TA-94 16 gauge 304 series stainless steel undershelf upgrade (per linear foot) - 18 Feet
- SS-1520 Deluxe Drawer, 15"W x 20"D x 5" deep drawer pan insert, stainless steel, with drawer slides - 3 Each
- TA-90 Drawer Adapter/Non Catalog Tables, specify table width (pair) - 9 Pair

Item No. 17 - TRANSPORT UTILITY CART Quantity: Two (2) Total

Rubbermaid Model No. FG409100BLA

- Xtra™ Utility Cart, 40-5/8"L x 20"W x 37-13/16"H, (3) shelves, 100 lb. capacity per shelf, open sided, (4) 4" swivel casters, assembly required, black, S.O.S. (Special Order Smallwares)

product; see SOS document for details

Item No. 18 - ROLL-THRU HEATED CABINET Quantity: Six (6) Total
Traulsen Model No. AIH132LP-FHS

- Spec-Line Heated Cabinet, Roll-thru, one-section, stainless steel exterior, aluminum interior, standard depth cabinet, full-height doors, accepts 66" high racks (by others) with INTELA-TRAUL™, cULus, NSF, ENERGY STAR®
- 208/115v/60/1ph, 7.8 amps, 1500 watts, NEMA L14-20P, standard
- 3 year service/labor warranty, standard
- Thermometer side door: hinging to be determined
- Rear door: hinging to be determined

Item No. 19 - ROLL-THRU REFRIGERATOR Quantity: Four (4) Total
Traulsen Model No. ARI132LPUT-FHS

- Spec-Line Refrigerator, Roll-thru, one-section, self-contained refrigeration, stainless steel exterior, aluminum interior, standard depth cabinet, full-height doors, accepts 66" high racks (by others) with INTELA-TRAUL™, 1/3 HP, cULus, NSF
- 115v/60/1ph, 11.6 amps, NEMA 5-15P, standard
- 3 year service/labor & 5 year compressor warranty, standard
- Thermometer side door: hinging to be determined
- Rear door: hinging to be determined

Item No. 20 NOT USED

Item No. 21 - CAN RACK Quantity: Two (2) Total
New Age Model No. 1250CK

- Can Storage Rack, mobile design with casters, sloped glides for automatic can retrieval, aluminum construction, holds 162-#10 or 216-#5 cans, (4) 6" plate casters, (2) swivel with brakes, (2) rigid, NSF
- Lifetime warranty against rust & corrosion, 5 year construction warranty, standard

Item Nos. 22, 23, 24 - COUNTER Quantity: One (1) Total
Countercraft Model SERVING COUNTER or pre-approved alternate

CounterCraft Modular Hot Food Unit, Quantity: Four (4), with Hatco GRSBF-60-O Built-in Heated Shelf. Provide counter with integral stainless steel cutting surface, cord and plug, with Adjustable Deluxe sneeze guard and lights. 120V/1P/60hz with NEMA 5-15P Locking Cap

CounterCraft Modular Recessed Frost Unit, Quantity: Two (2), with Hatco FTB 3. Provide counter with cord and plug, with Adjustable Deluxe sneeze guard with glass overshelf and lights. 120V/1P/60hz with NEMA 5-15P Locking Cap

CounterCraft Modular Recessed Frost Unit, Quantity: Two (2), with Hatco FTB 2. Provide counter with cord and plug, with Adjustable Deluxe sneeze guard with glass overshelf and lights. 120V/1P/60hz with NEMA 5-15P Locking Cap

CounterCraft 2-Person Cashier Unit (SCSL-48-MOD) with stainless steel tray slides of both sides of unit on fixed brackets. Provide unit with grommeted cut outs for POS cord access, cash

drawer with till. Provide unit with laminated decor panels with cord/plug.

Item No. 25 - REFRIGERATOR RACK, ROLL-IN Quantity: Ten (10) Total
New Age Model No. 4338

- Lifetime Series Roll-In Bun Pan Rack, heavy duty, aluminum, 64"H, (18) wide-angle runners are 1-1/2" x 3-1/4" x .100 with 3" spacing (non- adjustable), extruded aluminum guides for 12 x 20 to 18 x 26 pans, fully welded 1-1/2"x1-3/4" x .07" smooth wall D-tube uprights, (4) 5" platform swivel casters, NSF
- Lifetime guarantee against rust & corrosion. Lifetime guarantee against worksmanship and material defects.

Item No. 26 - HAND SINK Quantity: Two (2) Total
Advance Tabco Model No. 7-PS-50

- Hand Sink, wall mounted, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, with splash mounted faucet, lever drain with overflow, P-trap, wall bracket, NSF, cCSAus
- K-316-LUHA Wrist Handles Only, for splash or deck mount hand sink faucet (1 pair hot & cold 4" long blades), fits faucets supplied after November 2015 with hot & cold color rings that do not have exposed screw head

Item No. 27 – Walk-in Refrigerator - Refer to Section 11410

Item No. 28 – Walk-in Freezer - Refer to Section 11410

Item No. 29 - PLASTRIC SHELVING UNIT, WITH METAL POST Quantity: Six (6) Total
Metro Model No. 5Q357G3

- MetroMax Q™ Starter Shelving Unit, 48"W x 18"D x 74"H, (5) open grid polymer shelves with Microban® antimicrobial protection (4) epoxy coated steel, epoxy coat steel frame, KD, NSF

Item No. 30 - PLASTIC SHELVING UNIT, WITH METAL POST Quantity: Two (2) Total
Metro Model No. 5Q337G3

- MetroMax Q™ Starter Shelving Unit, 36"W x 18"D x 74"H, (5) open grid polymer shelves with Microban® antimicrobial protection (4) epoxy coated steel, epoxy coat steel frame, KD, NSF

Item No. 31 - PLASTIC SHELVING UNIT, WITH METAL POST Quantity: Eight (8) Total
Metro Model No. 5Q557G3

- MetroMax Q™ Starter Shelving Unit, 48"W x 24"D x 74"H, (5) open grid polymer shelves with Microban® antimicrobial protection (4) epoxy coated steel, epoxy coat steel frame, KD, NSF

Item No. 32 - DUNNAGE RACK Quantity: Two (2) Total
New Age Model No. 2009

- Dunnage Rack, 48"W x 24"D x 12"H, all welded aluminum construction, 1-1/2" x 1-3/4" x 0.070 tubing, welded aluminum caps on feet, weight capacity 2500 lbs., NSF
- Lifetime warranty against rust & corrosion, 5 year construction warranty, standard

Item No. 33 - FLOOR TROUGH Quantity: One (1) Total
Advance Tabco Model No. FTG-1848

- Floor Trough, 48"W x 18"D x 4" deep, 14 gauge 304 series stainless steel, includes stainless steel subway grating constructed from 3/16" x 1" bars, removable stainless steel strainer

basket, 4" O.D. waste pipe 3"L, pitched towards waste
- FT-1 Anti-Splash Guard, factory installed (per linear foot) - 4 Feet

Item No. 34 - FLOOR TROUGH Quantity: Two (2) Total
Advance Tabco Model No. FTG-1830
- Floor Trough, 30"W x 18"D x 4" deep, 14 gauge 304 series stainless steel, includes stainless steel subway grating constructed from 3/16" x 1" bars, removable stainless steel strainer basket, 4" O.D. waste pipe 3"L, pitched towards waste
- FT-1 Anti-Splash Guard, factory installed (per linear foot) - 6 Feet

Item No. 36 - WORK TABLE, STAINLESS STEEL TOP Quantity: Two (2) Total
Advance Tabco Model No. FSS-366
- Work Table, 72"W x 36"D, 14 gauge 304 series stainless steel top with 1-1/2"H rear upturn, 18 gauge stainless steel adjustable undershelf, stainless steel legs & adjustable bullet feet, NSF
- TA-96A Can Opener Provision for openers with bolt on base - 2 Each
- TA-255 Casters, expanding adapter, for 1-5/8" dia. O.D. tube/table legs, 400 lb capacity per caster, set of (4) (2 braked) 2 Sets
- TA-255B Upgrade heavy duty casters (TA-255, TA-256 only) to have brakes on all wheels - 2 Sets
- TA-366 Reinforced understructure for undershelves
- SS-1520 Deluxe Drawer, 15"W x 20"D x 5" deep drawer pan insert, stainless steel, with drawer slides - 6 Each
- TA-90 Drawer Adapter/Non Catalog Tables, specify table width (pair)
- Mid mount - 6 Pair
- TA-228 Mid mounting provision
- SCT-72 Pot Rack, table mounted, circular design, 72" long, stainless steel, includes: (18) plated pot hooks & (1) AUR-72 utensil rack
- TA-94 16 gauge 304 series stainless steel undershelf upgrade (per linear foot) - 12 Feet

CAN OPENER Quantity: One (1) Total
Edlund Packed 3 ea
- Can Opener, manual, #1™ with plated base (for cans up to 11" tall) "Old Reliable"™
- 1 year limited warranty, standard

END OF SECTION 11400

SECTION 11410 - WALK-IN COOLER/FREEZER

Item No. 31 / 32 - Combination Walk-In Cooler/Freezer:
Manufacturer/Model: American Panel or approved equal.
Provide and install as per specifications and manufacturer's recommendations.

A. VAULTS:

1. American Panel indoor cooler/freezer combination. Size as noted on the drawings, approx. 21'-4" long x 11'-0" deep. Construction shall be as approved by the National Sanitation Foundation, standard number 7.
2. Kitchen Equipment Contractor (KEC) to use American Panel factory certified installer and is responsible for all field-measurement verification.
3. Panel finish exposed exterior to be 22 gauge stainless steel #3 finish; unexposed exterior - 26 gauge stucco Acrylume; interior walls - .040 stucco aluminum; interior ceiling - .040 white stucco aluminum.
4. Panels are to be CFC free, 4" Urethane, UL listed class 1 panels with foam perimeter tongue and groove design with a flexible vinyl gasket for airtight seal. The gasket is NSF and impervious to grease, oil, stains and mildew. The AR= factor shall be 8.33 per square inch thickness. Insulation shall be 97% closed cell to prevent moisture absorption and a comprehensive strength at yield point of 35 lbs. per square inch.
5. Flames spread rating 25 or less and smoke density of 450, according to ASTME-84.
6. Floor to be 4" foamed-in-place manufactured floor with DATP finish.
7. Provide factory foamed-in-place APC System 100B fully programmable control system for both cooler and freezer. System 100B to include digital thermometer, temperature alarm, cyclic door heater & monitor, light switch with delay, non-volatile memory, service menu, and self-charging backup battery. Cooler and freezer compartments are to have 48" LED light fixtures and entry light fixture pre-wired to common j-box with backlit switches and weatherproof covers.
8. Panel height to be 9'-8" above finished floor.
9. Doors to be 34" X 77" Self Closing Type Door with three (3) hinges, finish to match panels, heated 14" x 14" view window, 48" high interior and exterior "integral" DATP kick plates, foot treadle, pressure relief vents, and CCI Clear view bi-fold doors mounted on inside of each door assembly. Provide evaporator cut off switch mounted on exterior doorframes, and doorstops at cooler freezer doors. A 2" diameter chrome face, flush mount adjustable dial thermometer shall be provided on exterior of door section to provide temperature readings of minus 40 degrees F to plus 300 degrees F.
10. Kitchen equipment contractor to trim areas between walls and ceiling with 18 gauge stainless steel closure panels and trim strips provided by American Panel. Provide hugged edge and adhere to wall panel with adhesive as required for a seamless finish. Exposed fasteners not acceptable.
11. Ten-year panel warranty. Not permitted are wood perimeter panels, polystyrene panels, high-density rails or board stock urethane.
12. Kitchen Equipment Contractor is responsible for interior and exterior sealing of ALL panel penetrations as per manufacturer's recommendations, along with overall fit and finish of panel installation**.**

B. REFRIGERATION:

1. Cooler to be medium temperature 35ºF hermetic pre-assembled remote condensing unit. Condensing unit to include thermostatic expansion valve, liquid

eye, filter dryer, solenoid valve, thermostat control, pressure control, contactor, vibration eliminator, defrost timer, compressor mounting stand, and shall include a five-year compressor warranty. Evaporator to be NSF and UL listed with Heavy-gauge rust free housing, angled drain fitting, staggered copper tubes corrugated into aluminum fins, and screw type terminal blocks for easy wiring. Kitchen Equipment Contractor to provide Copper drain lines from evaporator to be trapped outside the walk-in. All plumbing to be in accordance with local codes and regulations. Warrant refrigeration system compressors for 5 years. Furnish one-year warranty on refrigeration system, including parts and labor for one-year from date of substantial completion.

2. Freezer to be minus 10ºF hermetic basic remote condensing unit. Condensing unit to include thermostatic expansion valve, liquid eye, filter dryer, defrost timer, 12' drain line heater, solenoid valve, thermostat control, pressure control, contactor, vibration eliminator, compressor mounting stand, and shall include a five-year compressor warranty. Evaporator to be NSF and UL listed with Heavy-gauge rust free housing, angled drain fitting, staggered copper tubes corrugated into aluminum fins, separate defrost termination thermostat and fan delay thermostat, heater safety controls to prevent over-heating of coil, and screw type terminal blocks for easy wiring.
3. Kitchen Equipment Contractor to provide Copper drain lines from evaporator to be trapped outside the walk-in. Freezer drains shall be heated and insulated to prevent freezing. Warrant refrigeration system compressors for 5 years. Furnish one-year warranty on refrigeration system, including parts and labor for one-year from date of substantial completion.
4. Penetrations are to be made by the Walk-In manufacturer and are to be NSF approved PVC or EMT conduit as required for pull-wire and refrigeration piping to remote food service equipment or refrigeration systems.
5. Kitchen Equipment Contractor is to supply, erect and assemble Walk-In panels and refrigeration system complete with all refrigerant, oil, dials, dehydrators, gages, controls as required for proper operation of system. Check equipment provided and adjust to proper operating temperature. Both cooler & freezer systems housed under One (1) common Galvanized weather cover with remote winterization controls.
6. Refrigeration System Installation to include Type "L" hard copper tubing, dried, charged with inert gas and plugged, suitable for working pressure of 450 p.s.i.g. Refrigerate fittings to be wrought copper or brass designed for use with high temperature solder and suitable for working pressure of 450 p.s.i.g. Piping joints made with sliver solder (Sil-Foz) under an internally inert atmosphere of dry nitrogen. Properly suspend piping from and anchor to structure with adjustable hangers maximum 6 ft. O.C. Size suction lines to have maximum pressure drop 3 lbs. from receiver to evaporator. Grade all refrigerant lines to prevent trapping of oil. Install ArmaFlex foam plastic insulation not less than 1/2" thick on all suction lines which is to be taped and glued at joints. No slit insulation will be accepted. Pressure test refrigerant piping before any covering is applied using carbon dioxide or dry nitrogen and freon under pressure in accordance with manufacturer's recommended procedures. Pressure testing: high side, 300 p.s.i.g; low side, 150 p.s.i.g.

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

Each walk-in shall be supplied with a complete set of installation, operation and maintenance instructions to cover erection of walk-in, operating procedures and routine maintenance schedule.

Install a minimum of one-inch (1") insulation on all lines (inside and outside).

All penetrations shall be properly sealed (inside and outside).

Installation of Walk-in at job site by factory shall include the following responsibilities:

1. Provide penetrations for electrical, plumbing and fire control fixtures, and Seal said penetrations for moisture prevention and leakage.

2. All door sweep adjustments on bottom of doors to prevent air leakage.

3. Check all handle latches, hinges, and hardware for proper fit, attachment and adjustment.
4. Provide properly sized drain line, P-traps and heat tape where applicable.

5. Check all panels for alignment, seal and levelness.

6. Clean and inspect all surfaces for esthetic appearance.

7. Notify factory representative to check walk-in for squareness before electrical and plumbing connections are made.

8. If dimensions of walk-in are changed for any reason, the shelving layout will be affected and must be re-quoted.

9. Taking delivery of walk-in front freight company to check for damage in shipment.

10. Deliver, uncrate, set-in-place, installation and provision of final electrical, plumbing connections by licensed trades.

AIR CURTAINS

Provide air curtain equal to Marley/Leading Edge Environmental Series Air Curtain-3/4 HP Model 48" Model E48001-75. Provide one unit each at Cooler/Freezer Section of Walk-In 120v1 1-Phase. Install units above door openings.

HEATED PRESSURE RELIEF VENT

The freezer shall be equipped with one (1) each two way heater pressure relief vent to equalize pressure between interior and exterior caused by defrost cycles and openings of doors. Electrical service shall be 115/60/1.

SPECIAL ACCESSORIES

1. Provide 14" x 14" Peep Windows at each door.
2. Provide (2) each S/S Interior and Exterior Kickplates per door.
3. Provide Stainless Steel Closure Panel to suspended ceilings.
4. Provide Stainless Steel Trim Strips.
5. Provide (2) two Kason model #1810C00048 light fixture for cooler
   Provide (2) two each Kason model #1810F00048 light fixture for freezer.

SECTION 11450 - RESIDENTIAL EQUIPMENT

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Extent of residential equipment required is indicated on drawings and in schedules.

Types of residential equipment required include the following:

- Microwave
- Refrigerator
- Dishwasher
- Washer / Dryer

All appliances to be electrical powered

Mechanical and Plumbing requirements are specified in Division 15.

Electrical services and connections are specified in Division 16.

QUALITY ASSURANCE:

Certification Labels: Provide residential equipment which complies with standards and bears certification labels as follows:

Energy Ratings: Provide energy guide labels with energy cost analysis (annual operating costs) and efficiency information as required by Federal Trade Commission.

UL Standards: Provide residential equipment with UL labels.

Uniformity: Provide products of same manufacturer for each type of residential equipment required.

SUBMITTALS:

Product Data: Submit manufacturer's specifications and installation instructions for each type of residential equipment, including data indicating compliance with requirements. Submit operating and maintenance instructions for each item of residential equipment.

DELIVERY AND STORAGE:

Deliver products to project site in manufacturer's undamaged protective containers, after spaces to receive them have been fully enclosed.

SPECIFIED PRODUCT WARRANTIES:

Submit manufacturer's standard written warranty for each item of residential equipment.

PART 2 - PRODUCTS:

MATERIALS AND FABRICATION:

Colors: Provide manufacturer's standard colors as shown or scheduled. If no color indicated, provide white. Provide the following residential equipment:

Refrigerator:	GE Energy Star - GIE21GTHWW (2) req'd.
U.C. Refrigerator:	GE - GCE06GSHSB (1) req'd.
Microwave:	GE – PEM31DFWW (2) req'd.
Dishwasher:	GE - GLDT690JWW (2) req'd.
Dryer:	GE Super Capacity - Model GFDN160EJWW (1) req'd.
Washer:	GE Super Capacity - Model GFW1600JWW (1) req'd.

Note any substitutions must meet the above rough opening dimensions required in millwork and be Barrier Free units.

Manufacturer: Subject to compliance with requirements, provide products from one of the following manufacturer:

Whirlpool
General Electric
Hot Point
Frigidaire

PART 3 - EXECUTION

INSTALLATION:

General: Comply with manufacturer's instructions and recommendations.

Built In Equipment: Securely anchor units to supporting cabinetry or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.

Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate for proper operation of equipment.

Utilities: Refer to Divisions 15 and 16 for plumbing and electrical requirements.

ADJUST AND CLEAN:

Testing: Test each item of residential equipment to verify proper operation. Make necessary adjustments.

Accessories: Verify that accessory items required have been furnished.

Cleaning: Remove packing material from residential equipment items and leave units in clean condition, ready for operation.

END OF SECTION 11450

SECTION 11480 - RECREATIONAL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Provide sports equipment where shown on drawings, as specified herein, and as needed for a complete and proper installation.
B. Related;
1. Documents affecting work of this section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Section in Division 1 of these specifications.

1.2 SUBMITTALS:

A. Comply with pertinent provisions of Section 01340.
B. Product data; within 35 calendar days after Contractor has received the Owners Notice to Proceed, submit the following;

1. Materials list of items proposed to be provided under this section;
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
3. Dimensioned drawings as needed to depict the space required for these items, and their interface with the work of other trades.
4. Manufacturer's recommended installation procedures which, when approved by the Architect, will become the procedures used on the work.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with all specified requirements and the methods needed for proper performance of the work in this section.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01605.

PART 2 – PRODUCTS

Basis of Design: Porter Sports Equipment
All other manufacturers must receive prior approval before bidding.

2.1. BACKSTOPS AND GOALS

A. At Gymnasium, provide (6) Porter #917 Forward Fold backstops (with height adjusters); (6) #208-000 Center strut rectangular Backboard official size 72" x 42" x ½"; (6) #22302 Power Flex Goals; Provide optional padding kit to fit backboards. Refer to floor plan for locations of these units. Main court backstops are to be mounted at 10'-0" a.f.f. All units to have height adjuster.

2.2 WALL PADDING"B

A. Provide "Porter" #00560-1 Standard Vinyl-covered wall padding. Panels are to be constructed of fibers as ascribed for 2" bonded foam (firm). Covers shall be cemented to 3/8" thick high density oriented strand backing board and covered with a 15 oz. non-tear vinyl laminated material. Wall pads are to be 5'-10" high.
B. Flame retardant shall meet the California State Fire Marshall standards according to method 59030, comparable to the standards of UL-214 and IX NFPA-701.
C. Colors as selected by Architects office.
D. Supplier must field verify column conditions for proper mounting of padding to all exposed sides, that are exposed inside the playing area.

2.3 VOLLEY BALL EQUIPMENT

A. Provide the following. Porter Power Volleyball with No. 00851-000 Economy Standards (pair) at two (2) practice courts.
B. Provide One (1) Porter Powr-Rib II Competition Volleyball System with judges stand, padding accessories and transport cart, for main court.
C. Provide floor sleeves for all courts for new construction, 00870-200 at (6) locations. Brass covers will be required.

2.4 SCOREBOARD

QUANTITY (1) One – SPECTRUM Model 5243-C3 Basketball Scoreboard with Spectralite L.E.D. advanced light technology finished in *School Colors* with *Team Name* in place of HOME and *School Mascot* on face of each scoreboard. Includes 'Smart Power' Power Supplies.

QUANTITY (1) One – SPECTRUM Model 5105-C2 Basketball Scoreboard with Spectralite L.E.D. advanced light technology finished in *School Colors* with *Team Name* in place of HOME on face of each scoreboard. Includes 'Smart Power' Power Supplies.

QUANTITY (2) Two – MultiSport Radio Control Systems

2.5 SOCCER GOALS

- Pair – Porter Portable World Cup Soccer Goals (R-487200)
- Soccer Net (00491-824)
- Never Flat Flip Wheels (00293-000)
- Anchor System (00298-170)

PART 3 - EXECUTION

INSTALLATION:

Install equipment where shown on drawings and comply with manufacturer's instructions and final shop drawings. Provide accessories indicated and anchors, inserts, and other items required for installation of units and attachment of adjoining construction.

ADJUSTMENT AND CLEANING

Upon completion of installation, including work of other trades, lubricate, test and adjust

equipment to operate easily and in compliance with manufacturer's specifications.

Clean installed bleacher units on exposed and semi-exposed surfaces. Touch-up shop applied finishes restoring damaged or soiled area.

END OF SECTION 11480

SECTION 11761 - HOSPITAL CURTAINS

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Extent of Hospital Curtains is shown on drawings.

SUBMITTALS:

Product Data: Submit manufacturer's data and template drawings for each type of curtain and track, including data indicating compliance with requirements.

Samples: Submit samples of metal finishes and colors.

PRODUCT HANDLING

Deliver products to project site in manufacturer's undamaged protective containers.

Delay delivery until spaces to receive than have been fully enclosed.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS:

Track: Clickeze – Optitrac
Graber – 9-807 Track

Curtain: Clickeze – Chalet Shower Curtain
Staph Chek or Webb

Basis of Design: Clickeze Optitrac (White) and Chalet Shower Curtain (Mesh: White; Fabric: Blue Moon) at Clinic Room.

PART 3 - EXECUTION

INSTALLATION: Install unit in accordance with manufacturer's instructions. Securely anchor to adjacent walls and ceilings.

CLEANING AND PROTECTION:

Ensure that operating parts work freely and fit neatly. Adjust hardware and moving parts as necessary.

Repair or replace damaged parts, dents, buckles, abrasions, or other defects affecting appearance or serviceability, so that hospital curtains are in undamaged condition at time of final acceptance.

END OF SECTION 11761

SECTION 12300 - MANUFACTURED CABINETS AND CASEWORK

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Extent of laboratory casework and fixtures is shown on drawings.

Work includes the fabrication and installation of standard laboratory furniture components of base cabinet, wall cabinets, storage cabinets, tables, cabinet understructures for fume hoods, shelf units, and other units as indicated.

Tops, sinks, accessories and mechanical and electrical service fixtures common to laboratory casework are included as work of this section.

Service fixtures are supplied as part of this work. Installation of service fixtures is included under mechanical work of Division 15 and electrical work of Division 16.

QUALITY ASSURANCE:

Single Source Responsibility: Provide laboratory casework with tops, sinks, and service fixtures, manufactured or furnished by same laboratory furniture company for single responsibility.

Catalog Standards: Manufacturer's catalog numbers may be shown on drawings for convenience in identifying certain laboratory cabinet work. Unless modified by notation on drawings or otherwise specified, catalog description for indicated number constitutes requirements for each such cabinet.

The use of catalog numbers, and specific requirements set forth in drawings and specifications are not intended to preclude the use of any other acceptable manufacturer’s product or procedures which may be equivalent, but are given for purpose of establishing standard of design and quality for materials, construction and workmanship.

SUBMITTALS:

Product Data: Submit manufacturer's data and installation instructions for each type of laboratory furniture unit.

Samples: Submit 6" x 6" samples of specified finishes, including top material. Samples will be reviewed by Architect for color, texture, and pattern only. Compliance with other specified requirements is exclusive responsibility of Contractor.

Shop Drawings: Submit shop drawings for laboratory furniture showing plans, elevations, ends, cross-sections, service run spaces, location and type of service fixtures with lines thereto. Show details and location of anchorages and fitting to floors, walls, and base. Include layout of units with relation to surrounding walls, doors, windows, and other building components.

Coordinate shop drawings with other work involved.

PRODUCT HANDLING

Deliver wood laboratory furniture only after wet operations in building are completed.

Store completed wood laboratory furniture in a ventilated place, protected from the weather, with relative humidity therein of 50% or less at 70 deg. F (22 deg. C).

Protect finished surfaces from soiling and damage during handling and installation. Keep covered with polyethylene film or other protective covering.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS:
Indeco Sales, Inc.
Kewaunee Scientific Equipment Corp.
Campbell - Rhea.
South Texas Wood Mill

WOOD CASEWORK:

Definitions: The following definitions apply to wood laboratory casework units:

Exposed portions of casework include surfaces visible when doors and drawers are closed. Bottoms of cases more than 4'-0" above floor shall be considered as exposed. Visible members in open cases or behind glass doors also shall be considered as exposed portions.

Semi-exposed portions of casework includes those members behind opaque doors, such as shelves, divisions, interior faces of ends, case back, drawer sides, backs and bottoms, and back face of doors. Tops of cases 6' -6" or more above floor shall be considered semi-exposed.

Concealed portions of casework include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.

Plywood: Hardwood, PS-51, Good Grade (1), or softwood PS-1/ ANSI A199.1, Group 1, A-A, INT, of species to match color and grain of exposed members.

Cabinet Finish: Apply finishes as follows to all surfaces, whether exposed or not:

High Pressure Plastic Laminate over plywood core.

CASEWORK HARDWARE AND ACCESSORIES:

Provide manufacturer's standard, satin finish hardware units, unless otherwise indicated.

Counter tops, splashes and edges.

Reference Standard - NEMA LD3-1980, GP50, Abrasion Class 1.
1-1/4" thick plywood core.

Provide sink cutouts - core material at sink counter tops shall be exterior HDO plywood - particle board will not be accepted.

Hinges: Institutional type, 5 knuckle. Provide one pair for doors less than 4 ft. high and 1-1/2 pair for doors over 4 ft.

Pulls: Solid metal, for drawers and swing doors, mounted with 2 screws fastened from back. Provide 2 pulls for drawers over 24” wide.

Drawers: Hardwood bodies with hardboard bottoms. Provide full extension heavy duty metal HD100 - self closing glides and Stanley pulls with architect’s approval.

Door Catches: Nylon roller spring catch or dual self-aligning permanent magnet type.

Provide 2 catches on doors over 4 ft. high.

Drawer Stops: Designed to permit easy removal, and yet prevent inadvertant drawer removal. Provide on all drawers, located on the inside.

Label Holders: Provide where indicated, size to receive standard label cards approximately 1" x 2" nominal size, finished to match other exposed hardware.

Drawer and Cupboard Locks: Half-mortise type, 5-pin tumbler and dead bolt, round cylinder only exposed, brass with plated finish. Provide at all doors and drawers.

Shelves: 1" thick, reversible, finished both sides and banded all edges.

Cabinet Base Molding: Extruded vinyl or rubber, black, 4” high. Provide on exposed sides and fronts of floor-mounted cabinets.

Leg Shoes: Extruded vinyl or rubber, black, open bottom type.

Adjustable Shelf Supports: BHMA B84072, wrought steel, mortise mounted.

FABRICATION:

Fabricate laboratory furniture to dimensions, profiles, and details shown.

Assemble units in the shop in as large components as practicable to minimize field jointing.

Install hardware uniformly and precisely after final finishing is complete. Set hinges snug and flat in mortises unless otherwise indicated. Turn screws to flat seat. Adjust and align hardware so that moving parts operate freely and contact points meet accurately. Allow for final field adjustment after installation.

TOPS, SINKS, AND ACCESSORIES:

Tops, Box Curbs,, Splash Rim: Provide smooth, clean, exposed tops and edges, in uniform plane free of defects. Make exposed edges and corners uniformly rounded.

Top Sizes: Furnish tops in maximum practicable lengths.

Top Thickness: Maintain 1 -1/4" thickness with tolerance not exceeding plus or minus

1/32". Provide front and end overhang of 1" over base cabinets, formed with continuous drip groove on under surface 1/2" from edge.

Epoxy resin tops may be 1 -1/4" thick. Equal to Black Resin or equal at all counters.

SERVICE FIXTURES
Electrical Components, Devices, and Accessories shall be labeled to comply with NFPA 70, Article 100 and marked for its intended use.

Electrical Fixtures are 3-wire grounded, 20 A, 125V AC, with stainless steel cover plates and cadmium-plated steel boxes. Pedestal boxes are black, cast aluminum with conduit nipples and lock nuts. When specified, G.F.C.I., ground fault circuit interrupter fixtures are available. G.F.C.I. fixtures are 20 A, 125V AC, with black nylon faceplate.

Receptacles: Comply with NEMA WD 1, NEMA WD 6, FS W-C-596, and UL 498. Duplex type, Configuration 5 20R.

Epoxy resin sinks are drop-in style, non-glaring black, and specially modified epoxy resins, molded in one solid piece or optimum physical and chemical resistance. Inside corners are coved and the bottom is dished to the outlet. Outlets are polypropylene with 1-1/2 inch (38 mm) NPS threads.

Gas, Air and Vacuum Cocks: Ground key cocks, made from high grade, brass forgings, have integral ten serration, non-slip hose end. Wing or knob handle has color-coded index, is one-piece construction, precision ground, and lapped to fit cock chamber. Handle operates with a 1/4 turn, and is spring-loaded for constant pressure and automatic take up. Provide needlepoint valves for high pressures and oxygen service where scheduled.

Multiple Service Fixtures: Triple chrome plated or electro-statically applied polyester powder coated fixtures have one cold water faucet and two ground key cocks for gas, air, or vacuum services. Faucet has a rigid gooseneck, one four-arm or knob handle, and serrated hose nozzle. Vacuum breaker furnished when specified. Faucet with integral vacuum beaker is furnished, when specified. Ground key cocks have serrated non-slip hose end and color-coded, spring-loaded wing handles.

Service Fixtures: Triple chrome plating or electro-statically applied polyester powder coating, heavy-duty construction for water, gas, steam, or other services and specifically designed for laboratory use. Hot and/or cold Water Faucets are cast from red brass with color-coded index handles. Faucets have serrated hose nozzles, unless specified otherwise. Goosenecks are rigid. Fixture outlets are tapped 3/8-inch (10 mm) I.P.S. for aerators, vacuum breakers, hose connections, or other accessories.

Provide units complete with washers, locknuts, unions, nipples and other accessories for positive mounting to supporting laboratory units. Include wall and deck flanges, escutcheons, handle extension rods, remote valves and similar items required. Fabricate units to withstand test pressure of 100 psig.

See Plumbing and Electrical plans for location.

All Other Tables - See Drawings.

Material and Finish: Fabricate service fixtures from cast or forged red brass containing a minimum of 85% copper. Exposed surfaces including fittings and escutcheons, polished

chrome plated finish.

Service Outlets Identification: Provide colored plastic index discs with embossed identification letters at each service fixture handle or knob. Secure discs to fixture handles to be virtually tamper proof. Color - code discs as follows:

Service	Color	Code	Letter Color
Air	Orange	Air	Black
Gas	Blue	Gas	White
Cold Water	Green	CW	White

Ground Key Type Hose Cocks: Tapered core and handle of one piece forged brass, ground and lapped, held in place under constant spring pressure.

Handles: Provide 3-arm or 4-arm forged brass handles for valves, stops, faucets, remote controls, and cocks, except for ground key cocks, steam valves, and micro-adjustable needle cocks.

Needle Valves: Provide units with renewable self-centering floating cones and renewable seats of stainless steel or monel metal.

Water Valves or Faucets: Provide units with renewable barrel locked in valve body. Barrel shall contain all wearing parts, with renewable discs.

Remote Control Valves: Although straight through type are indicated, use angle valves where ever required.

Vacuum Breakers: Provide vacuum breakers on all water fixtures (hot or cold) equipped with serrated outlets.

PART 3 - EXECUTION

CASEWORK INSTALLATION:

Install plumb, level, true and straight with no distortions. Shim as required, using concealed shims. Where laboratory furniture abuts other finished work, scribe and apply filler strips for accurate fit with fasteners concealed where practicable.

Base Cabinets: Set cabinets straight, plumb, and level. Adjust sub-tops within 1/16" of a single plane. Fasten each individual cabinet to floor at toe space, with fasteners spaced 24" o.c. Bolt continuous cabinets together. Secure individual cabinets with not less than 2 fasteners into floor, where they do not adjoin other cabinets.

All base cabinets to be furnished with handicap accessible toe space - Typical.

Where required, assemble units into one integral unit with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16".

Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

INSTALLATION OF TOPS:

Field Jointing: Where practicable, make in same manner as factory jointing using dowels, splines, adhesives, and fasteners recommended by manufacturer. Locate field

joints as shown on accepted shop drawings, factory prepared so there is no job site processing of top and edge surfaces.

Fastenings: Use concealed clamping devices for field joints, except for natural stone, composition stone and epoxy tops, located within 6" of front, at back edges and at intervals not exceeding 24". Tighten in accordance with manufacturer's instructions to exert a constant, heavy clamping pressure at joints. Except for natural stone, composition stone and epoxy tops, secure tops to cabinets with "Z"-type fasteners or equivalent, using 2 or more fasteners at each front, end, and back.

For natural stone, composition stone, and epoxy tops, secure to cabinets with epoxy cement applied at each corner and along perimeter edges at not more than 48" o.c.

Workmanship: Abut top and edge surfaces in one true plane, with internal supports placed to prevent any deflection. Provide flush hairline joints in top units using clamping devices. At stone-type material joints, use manufacturer's recommended adhesives and holding devices to provide joint widths not more than 1/16" wide at any location, completely filled and flush with abutting edges.

Where necessary to penetrate tops with fasteners, countersink heads approximately 1/8" and plug hole flush with material equal in chemical resistance, color, hardness, and texture to top surface.

After installation, carefully dress joints smooth, remove any surface scratches, clean and polish entire surface.

Provide holes and cutouts as required for mechanical and electrical service fixtures.

Provide scribe moldings for closures at junctures of top, curb and splash with walls as recommended by manufacturer for materials involved. Use chemical resistant, permanently elastic sealing compound where recommended by manufacturer.

INSTALLATION OF SINKS:

Underside Installation: Use manufacturers recommended adjustable support system for table-type and cabinet-type installations.

Set top edge of sink unit firmly pressed to counter top, set in manufacturer's recommended chemical resistant sealing compound to produce a tight and fully leak proof joint. Adjust sink and securely support to prevent movement.

Semiflush Installation: Use stainless steel sink frame, complete with clamping lugs and pads. Before setting, apply a full coat of manufacturer's recommended sealant under rim lip and along top. Omit sink frame if sink fabricated with integral rim seal.

INSTALLATION OF ACCESSORIES:
Install in a precise manner in accordance with manufacturer's directions. Turn screws to a flat seat; do not drive. Adjust moving parts to operate freely without excessive bind.

CLEANING AND PROTECTION:
Repair or remove and replace defective work as directed upon completion of installation.

Clean shop-finished surfaces, touch-up as required, and remove or refinish damaged or

soiled areas, as acceptable to Architect.

Protection: Advise Contractor of procedures and precautions for protection of materials and installed laboratory furniture from damage by work of other trades.

END OF SECTION 12300

SECTION 12491 – WINDOW LOUVERS AND BLINDS

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 types of venetian blinds and accessories:

1. Miniblinds with aluminum louver slats

B. Related Sections include the following:

1. Division 5 Section "Formed-Metal Fabrications" for custom sheet-metal pockets for window treatments.
2. Division 6 Section "Miscellaneous Carpentry" for wood blocking and grounds for mounting horizontal louver blinds and accessories.

1.3 DEFINITIONS

A. Miniblind: Venetian blind with nominal 1-inch- (25-mm-) wide louver slat.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.

B. Shop Drawings: Show location and extent of horizontal louver blinds. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other Work, operational clearances, and relationship to adjoining work.

C. Samples for Initial Selection: For each colored component of each type of horizontal louver blind indicated.

1. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For the following products, prepared on Samples from the same material to be used for the Work.

1. Louver Slat: Not less than 12 inches (300 mm) long.

E. Window Treatment Schedule: Include horizontal louver blinds in schedule using same room designations indicated on Drawings.

F. Product Certificates: For each type of horizontal louver blind product, signed by product manufacturer.

G. Product Test Reports: For each type of horizontal louver blind product.

H. Maintenance Data: For horizontal louver blinds to include in maintenance manuals. Include the following:

1. Methods for maintaining horizontal louver blinds and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to finishes and performance.
3. Operating hardware.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain horizontal louver blinds through one source from a single manufacturer.

B. Corded Window Covering Product Standard: Provide horizontal louver blinds complying with WCMA A 100.1.

C. Mockups: Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.
1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver blinds in factory packages, marked with manufacturer and product name, and location of installation using same room designations indicated on Drawings and in a window treatment schedule.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet and dirty finish work in spaces, including painting, is complete 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 operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.8 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. Horizontal Louver Blinds: Before installation begins, for each size, color, texture, pattern, and gloss indicated, full-size units equal to 5 percent of amount installed, but not fewer than 6 units.

1.9 WARRANTY AND GUARANTEE

A. Special Installer's Guarantee: Installer's standard form in which Installer agrees to repair or replace all items, parts, equipment, etc. that do not comply with performance and other requirements specified in this Section within specified guarantee period.

1. Guarantee Period: Two (2) years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which all items, parts, equipment, etc. agrees to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Horizontal Louver Blinds, Aluminum Louver Slats: to be installed at each single hung window.

Basis of Design: Bali Horizontal Blinds, Springs Window Fashions Division, Inc.

Hunter Douglas Window Fashions.
Levolor Contract; a Newell Company; Levolor.

2.2 HORIZONTAL LOUVER BLINDS, ALUMINUM LOUVER SLATS

A. Louver Slats: Aluminum, alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radiused corners.
1. Nominal Slat Width: 1 inch (25 mm) for miniblinds.

a. Slat Spacing: Every 18 mm for 16.7 slats or more per foot (18 mm).
2. Nominal Slat Thickness: Not less than 0.006 inch (0.15 mm).
3. Slat Finish: four (4) colors maximum.

a. Ionized Coating: Antistatic, dust-repellent, baked polyester finish.

B. Headrail: Formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and ends; capacity for one blind per headrail, unless otherwise indicated on Drawings.

1. Finish Color Characteristics: Match color, texture, pattern, and gloss of louver slats.

C. Bottom Rail: Formed-steel or extruded-aluminum tube, sealed with plastic or metal capped ends top contoured to match crowned shape of louver slat; with enclosed and protected ladders and tapes to prevent their contact with sill.

D. Tilt Control: Consisting of enclosed worm gear mechanism, slip clutch or detachable wand preventing over rotation, and linkage rod, for the following operation:

1. Tilt Operation: Manual with clear plastic wand.
2. Length of Tilt Control: Length required to make operation convenient from floor level.
3. Tilt: Full.

E. Lift Operation: Manual, cord lock; locks pull cord to stop blind at any position in ascending or descending travel.

F. Tilt-Control and Cord-Lock Position: Right side and left side of headrail, respectively, unless otherwise indicated.

G. Ladders: Evenly spaced to prevent long-term louver sag.

1. For Blinds with Nominal Slat Width 1 Inch (25 mm) or Less: Braided string.

H. Mounting: As indicated on Drawings, mounting permitting easy removal and replacement without damaging blind or adjacent surfaces and finishes; with spacers and shims required for blind placement and alignment indicated.

1. Provide intermediate support brackets if end support spacing exceeds spacing recommended by manufacturer for weight and size of blind.

I. Side Channels and Perimeter Seals: Manufacturer's standard for eliminating light gaps when blinds are closed.

J. Safety: Provide safety releases on the cord to prevent choking. Provide hold down clips at bottom rails.

K. Colors, Textures, Patterns, and Gloss: As selected by Architect from manufacturer's full range.

2.3 FABRICATION

A. Fabricate venetian blinds and vertical blinds to fit measurements of finished openings obtained at site.

B. Venetian Blinds: Venetian blinds shall have two inch width horizontal slats positioned within ladder tapes. Multiple blinds in openings are to be of same type and divided at mullions.

1. Head-rails shall fully enclose operating mechanism on three sides and ends.
2. Bottom rails shall be fully enclosed to prevent contact of tapes and sill at underside.
3. Bottom rails and head boxes shall be aluminum.
4. Finish concealed metal work of head-rails including concealed mechanism, with one shop coat of paint. Do not paint parts that have non-rusting finish, or parts where motion of friction occurs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 HORIZONTAL LOUVER BLIND INSTALLATION

A. Install blinds level and plumb and aligned with adjacent units according to manufacturer's written instructions, and located so exterior louver edges in any position are not closer than 1 inch (25 mm) to interior face of glass. Install intermediate support as required to prevent deflection in headrail. Allow clearances between adjacent blinds and for operating glazed opening's operation hardware, if any.

B. Recessed: Install headrail concealed within blind pocket.

C. Provide hold down clips and break-thru tassels at each louver blind cord.

3.3 ADJUSTING

A. Adjust horizontal louver blinds to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean blind surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that horizontal louver blinds are without damage or deterioration at time of Substantial Completion.

C. Replace damaged blinds that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 12491

SECTION 12760-GYMNASIUM BLEACHERS

1. Part I General

1.1 Work:

A. Telescoping gymnasium bleachers.

1.2 Related Work:

A. Electrical

1.3 References: Applicable building codes: IBC ; Latest Edition

1.4 Description of the System

A. The bleacher system shall be comprised of multiple tiered, closed deck seating rows operating in a telescopic manner, incorporating the most economical quantity of sections while still complying with all loading requirements.

B. The first moving row shall be secured with friction or mechanical locks. Other rows shall be mechanically locked, operable only upon unlocking and cycling the first row, quantity to be determined by Interkal engineering.

C. Each bleacher row shall be comprised of risers, seat and deck components, and a complete set of supportive columns and braces.

D. The telescopic bleacher shall incorporate a locking system permitting the use of one, several, or all rows, each locked in the extended position.

1.5 Quality Assurance

A. Qualifications

1. Manufacturing: Manufacturer shall be regularly engaged in the design and manufacturing of telescopic seating for not less than twenty years.
2. Engineering: It will be mandatory that each bidder submit with their bid an affidavit signed by a Registered Professional Engineer stating that the product to be supplied has been tested by an independent testing facility and meets all applicable code requirements.

B. Deviations: It will be the responsibility of the bidder to furnish with their bid, a list clarifying any deviations from the specifications, written or implied. Those bidders not submitting a list of deviations will be presumed to have bid as specified.

C. Guarantees:

1. One-Year Guarantee: The manufacturer shall guarantee all work performed under these specifications to be free from defects for a period of one year.

D. Product Improvements: Seating provided shall incorporate manufacturer’s design improvements and materials current at time of shipment.

1.6 Submittals:

A. Submit manufacturer's installation instructions and descriptive literature in accordance with Section 01300.

B. Manufacturer's operating and maintenance manuals in accordance with Section 01700.

1.7 Design Criteria

A. Telescopic bleacher design and fabrication shall conform to (specify applicable code by year and ADA requirements)

B. Telescopic gymnasium seating will be designed to support a vertical live load of 100 PSF, but not less than 120 PLF on both seat boards and footboards. Seating shall also be designed to carry a horizontal sway force of 24 PLF parallel to the seating and 10 PLF perpendicular to the seating.

C. Steel components shall be cold-formed from appropriate width strip stock conforming to ASTM A570 - Grade C 30KSI, ASTM A653- Grade 33 and 50, ASTM A500 - Grade B 46 KSI as applicable.

D. Lumber components are kiln dried, finger jointed, edge glued southern pine of grade "B & B Finish" manufactured to the current SPIB glued-laminated standards for southern pine.

E. Plywood deck boards shall be fabricated from Douglas Fir Premium Underlayment with exterior glue, 5 ply minimum, solid crossband directly under face ply, species group 1 and manufactured in accordance with PS-1-95.

2. PART 2 PRODUCTS

2.1 Manufacturer

A. Telescopic seating as manufactured by Interkal, Kalamazoo, Michigan, is the standard of quality required and specified herein.

2.2 Materials

A. Model: Interkal, closed deck telescopic bleachers

B. Type: Wall attached

C. Quantity:

1. Provide 100'-0" wide banks; 8 rows high. (Approx 440 Seats)

D. ADA

1. Notchouts: Provide a 36" wide wheel chair space as shown on the plans and as required to meet local code jurisdiction compliance with ADA. (one row deep).

E. Dimensions:

1. Rise per row:- 10 -1/4”
2. Row to row spacing: - 24”

F. Propulsion - Friction Power- Furnish friction power, integral automatic electro-mechanical shaft driven propulsion system to open and close telescopic seating system.

1. Power: 1/2 H.P. 208V, 3-phase motor.
2. Column roller Assemblies: (2) two 6” diameter by 2 ½” wide cast 45-durometer rubber covered drive wheels for a minimum of four friction roller contact points per section of bleacher.
3. The pendant control voltage shall be 24 VAC @ less than 50 MA for the safety of all operating personnel. The entire power system shall be U.L. Recognized.

2.3 Accessories

A. Last Row Closure

1. Rear Closure Board: Provide and install a properly supported, flush mounted board between the last row of the bleacher and the wall.

B. Wheelchair Seating:

1. Notchouts: Provide manufacturers standard permanent handicap notchout (36” wide) located as shown on architectural plans. Notchouts must be located at section joints only to avoid interference with understructure. Fascia panels shall have manufacturers standard polydeck finish to match deck board surface. One row deep.

C. Front Railing: Provide rigid 36” high, fixed tubular steel rail with vertical intermediate members to fill design criteria. Rail to be mounted full width at all two row deep ADA wheelchair accommodations. Finish shall be a polyester powder coat. Front rails are to be designed to comply with all applicable codes and remain consistent with all other rails not allow clearance of a 4” sphere.

D. End Railing:

1. Self-Storing End Rails: Provide steel self-storing 42” high self-storing end guard rails with tubular supports and vertical intermediate members to comply with all code requirements. Rails shall be fitted to each exposed bank end from third row and above with all steel to steel connections. Finish shall be a polyester powder coat.

E. Operation

1. Pendant Control: Provide pendant control style operation for the bleachers. Extension and retraction shall be accomplished by use of the pendant control plugged into a single receptacle. The receptacle shall be mounted at the first row.

F. Numbering: Provide seat numbers and row letters for sculpture seat modules. Sequence to be determined by architect or owner.

G. Vinyl-End Curtains: Provide manufacturers standard vinyl end curtains to close off under the bleacher units in the extended position. Curtain color is to be selected from manufacturer's standard offering.

H. End Panels: Provide manufacturers standard end panels to close off the opening between end rails and the wall when the bleachers are stacked. (Not available with vinyl end curtains)

2.4 FABRICATION

A. Continuous Wheel Channel: Wheel channels shall consist of a one piece formed steel channel welded to the base of a vertical column. Wheel channels accommodate 8 to 12 wheels per row for maximum weight distribution and operating ease. The number of wheels increase as the number of rows increase.

B. Wheels: 3-1/2" diameter with 1-1/8" non-marring soft rubber face with rounded edges designed to protect wood or synthetic floor. Provide I/2" diameter axle for all wheels

C. Columns: Electrically welded closed rectangular steel tube, 2" x 3" minimum size, 14 gauge steel fitted with a rear welded gusset at the wheel channel.

D. Row Interlocks: Join each row structure front to rear by means of two (2) interacting steel connections, plus automatic gravity row locks where Engineering determines they are required.

1. Lower: Lower track guides shall be an external superslide rod to guarantee positive engagement of vertical supports without binding and assures smooth operation over uneven floor conditions.
2. Upper: Upper track guides shall completely interlock adjacent understructure support. A welded stop to ensure correct extension of bleacher unit on deck support. Use of bolt and nut stops are not acceptable, due to risk of loosening.

E. Diagonal Braces: Structural formed steel truss fitted to rows 4 and beyond. Bracing shall be attached to the rear riser at optimum locations to insure structural integrity. Bracing will be designed and shaped to support a minimum load of 1000(lbs) of both compression and tension forces created when the bleacher is loaded.

F. Deck Supports: Shall be of structural steel, 11 gauge spaced not greater than 60" on center for maximum deck stiffness.

1. Rollers: Every deck support not attached to a vertical post will have an integral nylon roller to avoid steel to steel friction points for more efficient operation.

G. Decking: All deck boards shall consist of 19/32" nominal Douglas Fir CC grade plywood with exterior glue and solid crossbands. An extruded aluminum "H" connector shall be placed between plywood panels. Exposed wear surfaces shall be finished with a layer of high Density polyethylene plastic .025 - .030 thick, Light Gray in color, complimentary to the seat option. Deck finishes, such as clear coat, requiring more than

simple touch up to restore it to a new appearance after wear occurs are unacceptable.

H. Welds: All welds shall be made at the factory by welders that are AWS certified on the equipment and process used.

I. Nose Beam: Shall be one-piece 13-gauge galvanized steel. 13-gauge steel is utilized for the necessary structural integrity to accommodate section lengths up to 26'

J. Rear Riser: Shall be one piece formed 14-gauge, grade 50, galvanized steel, with a continuous access joint to fully encapsulate footrest panel for ease of cleaning and additional structural support. 14-gauge roll formed steel is utilized for the necessary structural integrity to accommodate section lengths up to 26'.

K. Splice Plates: (For Friction or Non-Friction power only) Each section joint shall be tied together with two structural steel members per row, employing a minimum of four steel to steel through bolt connections at the nose beam and a minimum of eight steel to steel through bolt connections at the lower steel rear riser. Gauge of splice plates to match the gauge of the nose beam and rear riser. Splice plates employing steel to plywood deck board attachments will not be acceptable. Gauge of splice plates to match the gauge of the nose beam and rear riser. In order to minimize deflections and keep rows in alignment during operation, splice connections shall transfer both axial loads (tension/compression) and bending.

L. Fasteners: All structural connections shall be made with S.A.E. grade 5 or better stress rated bolts. The use of self-tapping bolts is not acceptable.

M. Finish:
1. Steel Understructure abraded, cleaned and finished with russet brown water base acrylic paint. Steel risers and nose beams finished with corrosion resistant silver gray matte finish with galvanized alloy plating.
2. Zinc plated (optional for high humidity areas).

2.5 Seat Options

A. SculptureSeat Modules:
1. 18-inch wide one-piece individual seating modules shall be constructed of high-density polyethylene. Provide in 12" deep.
2. Each module shall have two longitudinal and five transverse internal ribs to provide additional structural integrity and resistance to impact.
3. Each module shall have a full ½" interlock to the adjacent module both around the perimeter and along the internal ribs to eliminate pinching hazards and assures proper alignment.
4. A steel-to-steel attachment of each module to a minimum 14 gauge galvanized steel nosebeam shall be provided for maximum rigidity. All such mounting hardware shall be concealed.

5. End caps shall be provided at the ends of each bank (section, if manual) of seating as well as at each aisle.
6. Each module shall have a recessed area for optional seat numbering.
7. Select from manufacturers15 standard solid colors.

3. Part 3 Execution

3.1 Inspection:

A. Verify that areas to receive telescopic bleachers are free from impediments interfering with installation.

B. Do not begin work until building conditions are satisfactory.

3.2 Installation:

A. Install telescopic bleachers in accordance with manufacturer’s instructions and approved submittal drawings.

B. Adjust bleachers for smooth and proper operation.

C. Clean bleachers and remove all debris from gymnasium resulting from installation.

SECTION 14240 - MACHINE ROOM-LESS HYDRAULIC ELEVATORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Hydraulic passenger elevators as shown and specified. Elevator work includes:
   1. Standard pre-engineered hydraulic passenger elevators.
   2. Elevator car enclosures, hoistway entrances and signal equipment.
   3. Jack(s).
   4. Operation and control systems.
   5. Accessibility provisions for physically disabled persons.
   6. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.
   7. Materials and accessories as required to complete the elevator installation.

B. Related Sections:
   1. Division 1 General Requirements: Meet or exceed all referenced sustainability requirements.
   2. Division 3 Concrete: Installing inserts, sleeves and anchors in concrete.
   3. Division 4 Masonry: Installing inserts, sleeves and anchors in masonry.
   4. Division 5 Metals:
      a. Providing hoist beams, pit ladders, steel framing, auxiliary support steel and divider beams for supporting guide-rail brackets.
      b. Providing steel angle sill supports and grouting hoistway entrance sills and frames.
   5. Division 9 Finishes: Providing elevator car finish flooring and field painting unfinished and shop primed ferrous materials.
   6. Division 22 Plumbing:
      a. Sump pit and oil interceptor.
   7. Division 23: Heating and Ventilation:
      a. Heating and ventilating hoistways.
   8. Division 16 Sections:
      a. Providing electrical service to elevators. (note: fused disconnect switch to be provided as part of elevator manufacture product, see section 2.11 Miscellaneous elevator components for further details.)
      b. Emergency power supply, transfer switch and auxiliary contacts.
      c. Heat and smoke sensing devices.
      d. Convenience outlets and illumination in hoistway and pit.

C. Work Not Included: General contractor shall provide the following in accordance with the requirements of the Model Building Code and ANSI A17.1 Code. For specific rules, refer to ANSI A17.1, Section 300 for hydraulic elevators. State or local requirements must be used if more stringent.

   1. Elevator hoist beam to be provided at top of elevator shaft. Beam must be able to accommodate proper loads and clearances for elevator installation and operation.
   2. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports and bracing including all setting templates and diagrams for placement.
   3. Hatch walls require a minimum two hours of fire rating. Hoistway should be clear and plumb with variations not to exceed 1/2" at any point.
   4. Elevator hoistways shall have barricades, as required.
   5. Install bevel guards at 75° on all recesses, projections or setbacks over 2" (4" for A17.1 2000 areas) except for loading or unloading.
   6. Provide rail bracket supports at pit, each floor and roof. For guide rail bracket supports, provide divider beams between hoistway at each floor and roof.
   7. Pit floor shall be level and free of debris. Reinforce dry pit to sustain normal vertical forces from rails and buffers.

8. Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42'' minimum, (48'' minimum for A17.1-2000 areas) shall be provided at the same height, above sill of access door or handgrips.
9. All wire and conduit should run remote from the hoistways.
10. When heat, smoke or combustion sensing devices are required, connect to elevator control cabinet terminals. Contacts on the sensors should be sided for 12 volt D.C.
11. Install and furnish finished flooring in elevator cab.
12. Finished floors and entrance walls are not to be constructed until after sills and door frames are in place. Consult elevator contractor for rough opening size. The general contractor shall supply the drywall framing so that the wall fire resistance rating is maintained, when drywall construction is used.
13. Where sheet rock or drywall construction is used for front walls, it shall be of sufficient strength to maintain the doors in true lateral alignment. Drywall contractor to coordinate with elevator contractor.
14. Before erection of rough walls and doors; erect hoistway sills, headers, and frames. After rough walls are finished; erect fascias and toe guards. Set sill level and slightly above finished floor at landings.
15. To maintain legal fire rating (masonry construction), door frames are to be anchored to walls and properly grouted in place.
16. The elevator wall shall interface with the hoistway entrance assembly and be in strict compliance with the elevator contractor's requirements.
17. General Contractor shall fill and grout around entrances, as required.
18. All walls and sill supports must be plumb where openings occur.
19. Locate a light fixture (200 lx / 19 fc) and convenience outlet in pit with switch located adjacent to the access door.
20. As indicated by elevator contractor, provide a light outlet for each elevator, in center of hoistway.
21. For signal systems and power operated door: provide ground and branch wiring circuits.
22. For car light and fan: provide a feeder and branch wiring circuits to elevator control cabinet.
23. Controller landing wall thickness must be a minimum of 8 inches thick. This is due to the controller being mounted on the second floor landing in the door frame on the return side of the door. For center opening doors, the controller is located on the right hand frame (from inside the elevator cab looking out). These requirements must be coordinated between the general contractor and the elevator contractor.
24. Cutting, patching and recesses to accommodate hall button boxes, signal fixtures, etc.

1.02 SUBMITTALS

A. Product data: When requested, the elevator contractor will provide standard cab, entrance and signal fixture data to describe product for approval.

B. Shop drawings:
   1. Show equipment arrangement in the pit and hoistway. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.
   2. Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.
   3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.
   4. Indicate electrical power requirements and branch circuit protection device recommendations.

C. Powder Coat Paint selection: Submit manufacturer’s standard selection charts for exposed finishes and materials.

D. Plastic laminate selection: Submit manufacturer's standard selection charts for exposed finishes and materials.

E. Metal Finishes: Upon request, standard metal samples provided.

F. Operation and maintenance data. Include the following:
   1. Owners Manual and Wiring Diagrams.
   2. Parts list, with recommended parts inventory.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: An approved manufacturer with minimum fifteen years experience in manufacturing, installing, and servicing commercial elevators.
   1. Must be the manufacturer of the power unit, controller, signal fixtures, door operators cab, entrances, and all other major parts of the elevator operating equipment.
      a. The major parts of the elevator equipment shall be manufactured in the United States, and not be an assembled system.
   2. The manufacturer shall have a documented, on-going quality assurance program.
   3. ISO-9001:2000 Manufacturer Certified.
   4. ISO-14001:2004 Environmental Management System Certified.
   5. LEED Gold certified elevator manufacturing facility.

B. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than fifteen years of satisfactory experience installing elevators equal in character and performance to the project elevators.

C. Regulatory Requirements:
   1. ASME/ANSI A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.
   2. Building Code: National.
   3. NFPA 70 National Electrical Code.
   4. NFPA 80 Fire Doors and Windows.
   5. Americans with Disabilities Act Accessibility Guidelines (ADAAG).
   6. CAN/CSA C22.1 Canadian Electrical Code.
   7. CAN/CSA B44 Safety Code for Elevators and Escalators.
   8. California Department of Public Health Standard Method V1.1–2010, CA Section 01350

D. Fire-rated Entrance Assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, CAN4-S104 (ULC-S104), UL10(B), and NFPA 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory (2 hour label in Canada).

E. Inspection and testing: Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
   1. Arrange for inspections and make required tests.
   2. Deliver to the Owner upon completion and acceptance of elevator work.

F. Product Qualifications:
   1. LCA, EPD and HPD data must be provided for all major components of the elevator system.
   2. LCA data must be compatible with GaBI Software.
   3. Environmental Product Declaration (EPD): Publicly available, critically reviewed life cycle analysis having at least a cradle-to-gate scope.

   4. GreenScreen Chemical Hazard Analysis: All ingredients of 100 parts-per-million or greater evaluated using GreenScreen for Safer Chemicals Method v1.2.

5. Health Product Declarations (HPD v2 or later): Complete, published declaration with full disclosure of known hazards, prepared using the Health Product Declaration Collaborative's "HPD builder" on-line tool; Unknown hazard listed will not be considered acceptable.

1.04 DELIVERY, STORAGE AND HANDLING

A. Manufacturing will deliver elevator materials, components and equipment and the contractor is responsible to provide secure and safe storage on job site.

1.05 PROJECT CONDITIONS

A. Prohibited Use: Elevators shall not be used for temporary service or for any other purpose during the construction period before Substantial Completion and acceptance by the purchaser unless agreed upon by Elevator Contractor and General Contractor with signed temporary agreement.

1.06 WARRANTY

A. Warranty: Submit elevator manufacturer's standard written warranty agreeing to repair, restore or replace defects in elevator work materials and workmanship not due to ordinary wear and tear or improper use or care for 12 months after completion of installation or acceptance thereof by beneficial use, whichever is earlier.

1.07 MAINTENANCE

A. Furnish maintenance and call back service for a period of 12 months for each elevator after completion of installation or acceptance thereof by beneficial use, whichever is earlier, during normal working hours, excluding callbacks. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation.

1. Manufacturer shall have a service office and full time service personnel within a 100 mile radius of the project site.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer: Otis Elevator

2.02 MATERIALS, GENERAL

A. All Elevator Cab materials including frame, buttons, lighting, wall and ceiling assembly, laminates and carpet shall have an EPD and an HPD, and shall meet the California Department of Public Health Standard Method V1.1–2010, CA Section 01350 as mentioned in 1.03.9 of this specification.

B. Colors, patterns, and finishes: As selected by the Architect from manufacturer's standard colors, patterns, and finish charts.

C. Steel:
1. Shapes and bars: Carbon.
2. Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.
3. Finish: Factory-applied baked enamel for structural parts, powder coat for architectural parts. Color selection must be based on elevator manufacture’s standard selections.

D. Plastic laminate: Decorative high-pressure type, complying with NEMA LD3, Type GP-50 General Purpose Grade, nominal 0.050" thickness. Laminate selection must be

based on elevator manufacture's standard selections.

E. Flooring: Radial Tile Flooring – See Section 09650.

2.03 HOISTWAY EQUIPMENT

A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood subfloor. Underside of the platform shall be fireproofed. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25% of the rated capacity.

B. Sling: Steel stiles affixed to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.

C. Guide Rails: Steel, omega shaped, fastened to the building structure with steel brackets.

1. Guide Shoes: Slide guides shall be mounted on top and bottom of the car.

2. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on a steel template that is fastened to the pit floor. Provide extensions if required by project conditions.

3. Jack: Jack unit shall be of sufficient size to lift the gross load the height specified. Factory test jack to insure adequate strength and freedom from leakage. Brittle material, such as gray cast iron, is prohibited in the jack construction. Provide the following jack type: Twin post holeless telescopic 2-stage. Two jacks piped together, mounted one on each side of the car with each having two telescopic sections designed to extend in a synchronized manner when oil is pumped into the Assembly. Each jack section will be guided from within the casing or the plunger assembly used to house the section. Each plunger shall have a high pressure sealing system which will not allow for seal movement or displacement during the course of operation. Each Jack Assembly shall have a check valve built into the assembly to allow for automatically re-syncing the two plunger sections by moving the jack to its fully contracted position. The jack shall be designed to be mounted on the pit floor or in a recess in the pit floor. Each jack section shall have a bleeder valve to discharge any air trapped in the section.

4. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the landings and correct for overtravel or undertravel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.

5. Wiring, Piping, and Oil: Provide all necessary hoistway wiring in accordance with the National Electrical Code. All necessary code compliant pipe and fittings shall be provided to connect the power unit to the jack unit. Provide proper grade readily biodegradable oil as specified by the manufacturer of the power unit (see Power Unit section 2.04.G for further details).

6. Pit moisture/water sensor located approximately 1 foot above the pit floor to be provided. Once activated, elevator will perform "flooded pit operation", which will run the car up to the designated floor, cycle the doors and shut down and trip the circuit breaker shunt to remove 3 phase power from all equipment, including pit equipment.

7. Motorized oil line shut-off valve shall be provided that can be remotely operated from the controller landing service panel. Also a means for manual operation at the valve in the pit is required.

2.04 POWER UNIT

A. Power Unit (Oil Pumping and Control Mechanism): A self-contained unit located in the elevator pit consisting of the following items:
   1. NEMA 4/Sealed Oil reservoir with tank cover including vapor removing tank breather
   2. An oil hydraulic pump.
   3. An electric motor.
   4. Electronic oil control valve with the following components built into single housing; high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and electro-magnetic controlling solenoids.

B. Pump: Positive displacement type pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and quiet operation. Output of pump shall not vary more than 10 percent between no load and full load on the elevator car.

C. Motor: Standard manufacture motor specifically designed for oil-hydraulic elevator service. Duty rating – motors shall be capable of 80 starts per hour with a 30% motor run time during each start.

D. Oil Control Unit: The following components shall be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.
   1. Relief valve shall be adjustable and be capable of bypassing the total oil flow without increasing back pressure more than 10 percent above that required to barely open the valve.
   2. Up start and stop valve shall be adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up starts and up stops.
   3. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.
   4. Lowering valve and leveling valve shall be adjustable for down start speed, lowering speed, leveling speed and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling after slowdown is initiated.
   5. Provided with constant speed regulation in both up and down direction. Feature to compensate for load changes, oil temperature, and viscosity changes.
   6. Solid State Starting: Provide an electronic starter featuring adjustable starting currents.
   7. A secondary hydraulic power source (powered by 110VAC single phase) must be provided. This is required to be able to raise (reposition) the elevator in the event of a system component failure (i.e. pump motor, starter, etc.)
   8. Oil Type: Readily biodegradable that is USDA certified biobased product, ultra low toxicity, readily biodegradable, energy efficient, high performing fluid made from canola oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives. Especially formulated for operating in environmentally sensitive areas. USDA certified biobased product, 95% bio-based content, per ASTM D6866.

2.05 HOISTWAY ENTRANCES

A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening bolted\knock down construction.
   1. Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates, sight guards, and necessary hardware.
   2. Main landing door & frame finish: ASTM A1008 steel panels, factory applied powder coat finish.
   3. Typical door & frame finish: ASTM A 366 steel panels,factory applied powder coat enamel finish.

B. Integrated Control System: the elevator controller to be mounted to hoistway entrance above 1st landing. The entrance at this level, shall be designed to accommodate the control system and provide a means of access to critical electrical components and troubleshooting features. See section 2.09 Control System for additional requirements.

C. At the controller landing, the hoistway entrance frame shall have space to accommodate and provide a lockable means of access (group 2 security) to a 3 phase circuit breaker. See section 2.11 Miscellaneous Elevator Components for further details.

D. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.

E. Door Hanger and Tracks: Provide sheave type two point suspension hangers and tracks for each hoistway horizontal sliding door.
   1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.
   2. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.
   3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.

F. Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide mill finish on aluminum.

2.06 CAR ENCLOSURE

A. Car Enclosure:
   1. Walls: Cab type TKLP, durable wood core finished on both sides with high pressure plastic laminate.
   2. Canopy: Cold-rolled steel with hinged exit.
   3. Ceiling: Downlight type, metal pans with suspended LED downlights.
   4. Cab Fronts, Return,Transom, Soffit and Strike: Provide panels faced with brushed stainless steel.
   5. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.
      a. Door Finish: ASTM A1008 steel panels, factory applied powder coat enamel finish.
      b. Cab Sills: Extruded aluminum, mill finish.
   6. Handrail: Provide 1.5'' diameter cylindrical metal on side and rear walls on front opening cars and side walls only on front and rear opening cars. Handrails shall have a stainless steel, no. 4 brushed finish.
   7. Ventilation: Manufacturer’s standard exhaust fan, mounted on the car top.

B. Car Top Inspection: Provide a car top inspection station with an “Auto-Inspection” switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station will give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

2.07 DOOR OPERATION

A. Door Operation: Provide a direct current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. Door movements shall be electrically cushioned at both limits of travel and the door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. Closed-loop, microprocessor

controlled motor-driven linear door operator, with adjustable torque limits, also acceptable. AC controlled units with oil checks or other deviations are not acceptable.

1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.
2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel will reverse and the door will reopen to answer the other call.
4. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer will sound. When the obstruction is removed, the door will begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors will stop and resume closing only after the obstruction has been removed.
5. Limited Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors will reverse and reopen partially. After the obstruction is cleared, the doors will begin to close.
6. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors will recycle closed then attempt to open six times to try and correct the fault.
7. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors will recycle open then attempt to close six times to try and correct the fault.
8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.

B. Door Protection Devices: Provide a door protection system using 150 or more microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

2.08 CAR OPERATING STATION

A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Swing return shall have a brushed stainless steel finish. The main car operating panel shall be mounted in the return and comply with handicap requirements. Pushbuttons that illuminate using long lasting LED’s shall be included for each floor served, and emergency buttons and switches shall be provided per code. Switches for car light and accessories shall be provided.

B. Emergency Communications System: Integral phone system provided.

C. Auxiliary Operating Panel: Not Required

D. Column Mounted Car Riding Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.

E. Special Equipment: Limited Access Operation: Keyswitch and card reader space.(card reader by others)

2.09 CONTROL SYSTEMS

A. Controller: Shall be integrated in a hoistway entrance jamb. Should be microprocessor based, software oriented and protected from environmental extremes and excessive vibrations in a NEMA 1 enclosure. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.

B. Service Panel – to be located outside the hoistway in the controller entrance jamb and shall provide the following functionality/features:
   1. Access to main control board and CPU
   2. Main controller diagnostics
   3. Main controller fuses
   4. Universal Interface Tool (UIT)
   5. Remote valve adjustment
   6. Electronic motor starter adjustment and diagnostics
   7. Operation of pit motorized shut-off valve with LED feedback to the state of the valve in the pit
   8. Operation of auxiliary pump/motor (secondary hydraulic power source)
   9. Operation of electrical assisted manual lowering
   10. Provide male plug to supply 110VAC into the controller
   11. Run/Stop button

C. Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.

D. Special Operation: Limited Access Operation: A key switch shall be provided to initiate the Limited Access Operation. The activation of this operation shall restrict the operation of the elevator car calls to selected floors on a per-floor, per elevator basis. Travel to the restricted floors shall be allowed after the entry of the required access code via a card reader device supplied by others. The card reader entry shall override the car call restrictions and allow entry of a car call to a restricted floor.

E. Emergency Power Operation: (Battery Lowering 10-DOC) When the loss of normal power is detected, a battery lowering feature is to be activated. The elevator will lower to a predetermined level and open the doors. After passengers have exited the car, the doors will close and the car will shutdown. When normal power becomes available, the elevator will automatically resume operation. The battery lowering feature is included in the elevator contract and does not utilize a building-supplied standby power source.

2.10 HALL STATIONS

A. Hall Stations, General: Provide buttons with red-illuminating LED halos to indicate that a call has been registered at that floor for the indicated direction. Provide 1 set of pushbutton risers.
   Provide one pushbutton riser with faceplates having a brushed stainless steel finish.
   1. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.
   2. Provide ON/OFF key switch for Owner operation on first floor station.

B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.

C. Hall Position Indicator: An electronic dot matrix position indicator shall be provided and mounted for optimum viewing. As the car travels, its position in the hoistway shall be indicated by the illumination of the alphanumeric character corresponding to the landing which the elevator is stopped or passing. When hall lanterns are provided, the position

indicator shall be combined with the hall lanterns in the same faceplate. Faceplates shall match hall stations. Provide at all typical landings.

D. Hall lanterns: Not Applicable

E. Special Equipment: Not Applicable

2.11 MISCELLANEOUS ELEVATOR COMPONENTS

A. Oil Hydraulic Silencer: Install multiple oil hydraulic silencers (muffler device) at the power unit location. The silencers shall contain pulsation absorbing material inserted in a blowout proof housing.

B. Lockable three phase circuit breaker with auxiliary contact with shunt trip capability to be provided. Circuit breaker to be located behind locked panel (Group 2 security access) at controller landing entrance jamb and should be sized according to the National Electrical Code.

C. Lockable single phase 110V circuit breaker for cab light and fan to be provided. Circuit breaker to be located behind locked panel (Group 2 security access) at controller landing entrance jamb should be sized according to the National Electrical Code.

D. Elevator Phone Cellular Interface: Provide cellular interface equal to Rath Microtech Series 2100 for GSM cellular technology. Confirm cellular carrier with Owner. Sim card and Voice Only plan will be provided by the Owner.

PART 3 EXECUTION

3.01 EXAMINATION

A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and control space, as constructed and verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 INSTALLATION

A. Install elevator systems components and coordinate installation of hoistway wall construction.
   1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.
   2. Comply with the National Electrical Code for electrical work required during installation.

C. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.

D. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.

E. Lubricate operating parts of system where recommended by manufacturer.

3.03 FIELD QUALITY CONTROL

A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required by A17.1 Code and local authorities having jurisdiction. Perform other tests, if any, as required by governing regulations or agencies.

B. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.04 ADJUSTING

A. Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.05 CLEANING

A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless stall shall be cleaned with soap and water and dried with a non-abrasive surface; shall not be cleaned with bleached-based cleansers.

B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.
   1. Use environmentally preferable and low VOC emitting cleaners for each application type. Cleaners that contain solvents, pine and/or citrus oils are not permitted.

3.06 PROTECTION

A. At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.07 DEMONSTRATION

A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.

B. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

3.08 ELEVATOR SCHEDULE

A. Elevator Qty. 1
   1. Elevator Model: HydroFit Elevator System
   2. Rated Capacity: 2100 lbs.
   3. Rated Speed: 100 ft./min.
   4. HP: 20
   5. Travel: 14'-8"
   6. Landings: 2 total
   7. Openings:
      a. Front: 2
      b. Rear: 0
   8. Clear Car Inside: 5' - 8" wide x 4' - 3" deep
   9. Cab Height: 7’-9”

10. Floor Recess: 5/16”
11. Hoistway Entrance Size: 3' - 0" wide x 7'-0" high
12. Door Type: Single Speed
13. Power Characteristics: 460 volts, 3 Phase, 60 Hz.
14. Seismic Requirements: Zone 1
15. Fixture & Button Style: Brushed Stainless, Mounted in Jamb, flat, Button with illuminated Halo.
16. Special Operations: Limited Access with card readers by others.

END OF SECTION

SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION 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. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Smith, Jay R. Mfg. Co.
2. Zurn Industries, LLC.

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, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, 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: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. HOLDRITE.

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: Cast-iron wall sleeves.

2. Exterior Concrete Walls below Grade: Cast-iron wall sleeves with sleeve-seal system.
   a. 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: Cast-iron wall sleeves with sleeve-seal system.
   a. 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: Galvanized-steel-pipe sleeves

5. Interior Partitions: Galvanized-steel-pipe sleeves

END OF SECTION 210517

SECTION 210518 - ESCUTCHEONS FOR FIRE-SUPPRESSION 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-plated and rough-brass finish 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-plated and rough-brass finish and with concealed hinge and setscrew.

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 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. Insulated Piping: One-piece, stamped-steel type.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
f. Bare Piping in Equipment Rooms: One-piece, cast-brass type with rough-brass finish.

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.
2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 210518

SECTION 211313 - WET-PIPE SPRINKLER 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. Pipes, fittings, and specialties.
2. Cover system for sprinkler piping.
3. Specialty valves.
4. Sprinklers.
5. Alarm devices.
6. Manual control stations.
7. Control panels.
8. Pressure gages.

B. Verify fire line flow and pressure test data with Civil Engineer. If available flow and pressure are not adequate, provide a fire pump as required.

C. Related Requirements:

1. Section 211119 "Fire Department Connections" for exposed-, flush-, and yard-type fire department connections.

1.3 DEFINITIONS

A. Standard Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Domestic water piping.
2. Compressed air piping.
3. HVAC hydronic piping.
4. Ductwork.
5. Plumbing systems.
6. Items penetrating finished ceiling include the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.

B. Qualification Data: For qualified Installer and professional engineer.

C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

D. Welding certificates.

E. Fire-hydrant flow test report.

F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

G. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

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. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional certified at NICET Level 3 or higher.

B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

1.9 FIELD CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Architect no fewer than 7 days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13.
2. NFPA 13R.

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Delegated Design: Engage a qualified professional, as defined in Section 014000 "Quality Requirements," to design wet-pipe sprinkler systems.

1. Coordinate fire-hydrant flow test records with Architect and Civil Engineer.

2. Sprinkler system design shall be approved by authorities having jurisdiction.

a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
b. Sprinkler Occupancy Hazard Classifications:
1) Building Service Areas: Ordinary Hazard, Group 1.
2) Electrical Equipment Rooms: Ordinary Hazard, Group 1.

3) General Storage Areas: Ordinary Hazard, Group 1.
4) Libraries except Stack Areas: Light Hazard.
5) Library Stack Areas: Ordinary Hazard, Group 2.
6) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
7) Office and Public Areas: Light Hazard.
8) Classrooms: Light Hazard.

3. Minimum Density for Automatic-Sprinkler Piping Design:
   a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
   b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
   c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
   d. Special Occupancy Hazard: As determined by authorities having jurisdiction.

4. Maximum Protection Area per Sprinkler: According to UL listing.
5. Maximum Protection Area per Sprinkler:
   a. Office Spaces: 120 sq. ft.
   b. Storage Areas: 130 sq. ft.
   c. Mechanical Equipment Rooms: 130 sq. ft.
   d. Electrical Equipment Rooms: 130 sq. ft.
   e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
   a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
   b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

2.2 STEEL PIPE AND FITTINGS

A. Standard-Weight, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 30, Galvanized- and Black-Steel Pipe: ASTM A 135/A 135M; ASTM A 795/A 795M, Type E; or ASME B36.10M wrought steel, with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.

C. Galvanized- and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

D. Galvanized- and Uncoated-Steel Couplings: ASTM A 865/A 865M, threaded.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME 16.1, Class 125.

G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

H. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

I. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International.
b. Corcoran Piping System Co.
c. Shurjoint Piping Products.
d. Tyco Fire & Building Products LP.
e. Victaulic Company.

2. Pressure Rating: 175-psig minimum.

3. Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

J. Steel Pressure-Seal Fittings: UL 213, FM Global-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Victaulic Company.

2.3 PIPING JOINING MATERIALS

A. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.

B. Ball Valves:

1. Manufacturers:

a. Anvil International, Inc.
b. Victaulic Company.

2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
5. Valves NPS 3: Ductile-iron body with grooved ends.

C. Bronze Butterfly Valves:
1. Manufacturers:

a. Fivalco Inc.
b. Global Safety Products, Inc.
c. Milwaukee Valve Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

D. Iron Butterfly Valves:
1. Manufacturers:

a. Anvil International, Inc.
b. Fivalco Inc.
c. Global Safety Products, Inc.
d. Kennedy Valve; a division of McWane, Inc.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Pratt, Henry Company.
h. Shurjoint Piping Products.
i. Tyco Fire & Building Products LP.
j. Victaulic Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Cast or ductile iron.
5. Style: wafer.
6. End Connections: Grooved.

E. Check Valves:
1. Manufacturers:

a. AFAC Inc.
b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
c. Anvil International, Inc.
d. Crane Co.; Crane Valve Group; Crane Valves.
e. Crane Co.; Crane Valve Group; Jenkins Valves.
f. Crane Co.; Crane Valve Group; Stockham Division.
g. Fire Protection Products, Inc.
h. Fivalco Inc.
i. Globe Fire Sprinkler Corporation.
j. Groeniger & Company.

k. Kennedy Valve; a division of McWane, Inc.
l. Matco-Norca.
m. Metraflex, Inc.
n. Milwaukee Valve Company.
o. Mueller Co.; Water Products Division.
p. NIBCO INC.
q. Potter Roemer.
r. Reliable Automatic Sprinkler Co., Inc.
s. Shurjoint Piping Products.
t. Tyco Fire & Building Products LP.
u. United Brass Works, Inc.
v. Venus Fire Protection Ltd.
w. Victaulic Company.
x. Viking Corporation.
y. Watts Water Technologies, Inc.

2. Standard: UL 312.
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

F. Bronze OS&Y Gate Valves:
1. Manufacturers:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. United Brass Works, Inc.

2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

G. Iron OS&Y Gate Valves:
1. Manufacturers:

a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
b. American Valve, Inc.
c. Clow Valve Company; a division of McWane, Inc.
d. Crane Co.; Crane Valve Group; Crane Valves.
e. Crane Co.; Crane Valve Group; Jenkins Valves.
f. Crane Co.; Crane Valve Group; Stockham Division.
g. Hammond Valve.
h. Milwaukee Valve Company.
i. Mueller Co.; Water Products Division.
j. NIBCO INC.
k. Shurjoint Piping Products.
l. Tyco Fire & Building Products LP.

m. United Brass Works, Inc.
n. Watts Water Technologies, Inc.

2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

H. Indicating-Type Butterfly Valves:
1. Manufacturers:

a. Anvil International, Inc.
b. Fivalco Inc.
c. Global Safety Products, Inc.
d. Kennedy Valve; a division of McWane, Inc.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Shurjoint Piping Products.
h. Tyco Fire & Building Products LP.
i. Victaulic Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:

a. Valve Type: Ball or butterfly.
b. Body Material: Bronze.
c. End Connections: Threaded.

5. Valves NPS 2-1/2 and Larger:

a. Valve Type: Butterfly.
b. Body Material: Cast or ductile iron.
c. End Connections: Flanged, grooved, or wafer.

6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch indicating device.

I. NRS Gate Valves:
1. Manufacturers:

a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
b. American Valve, Inc.
c. Clow Valve Company; a division of McWane, Inc.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Kennedy Valve; a division of McWane, Inc.
f. Mueller Co.; Water Products Division.
g. NIBCO INC.
h. Tyco Fire & Building Products LP.

2. Standard: UL 262.

3. Pressure Rating: 250 psig minimum
4. Body Material: Cast iron with indicator post flange.
5. Stem: Nonrising.
6. End Connections: Flanged or grooved.

J. Indicator Posts:
1. Manufacturers:

a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
b. American Valve, Inc.
c. Clow Valve Company; a division of McWane, Inc.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Kennedy Valve; a division of McWane, Inc.
f. Mueller Co.; Water Products Division.
g. NIBCO INC.
h. Tyco Fire & Building Products LP.

2. Standard: UL 789.
3. Type: Horizontal for wall mounting.
4. Body Material: Cast iron with extension rod and locking device.
5. Operation: Hand wheel.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

2.6 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:

1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Globe Fire Sprinkler Corporation.

b. Reliable Automatic Sprinkler Co., Inc. (The).
c. Tyco Fire & Building Products LP.
d. Victaulic Company.

2. Standard: UL 193.

3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
7. 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

G. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Reliable Automatic Sprinkler Co., Inc. (The).
b. Tyco Fire & Building Products LP.

2. Standard: UL 1726.

3. Pressure Rating: 175-psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.7 HOSE CONNECTIONS

A. Manufacturers:

1. AFAC Inc.
2. Central Sprinkler Corp.
3. Elkhart Brass Mfg. Co., Inc.
4. Fire-End and Croker Corp.
5. Fire Protection Products, Inc.
6. GMR International Equipment Corporation.
7. Grinnell Fire Protection.
8. Guardian Fire Equipment Incorporated.
9. McWane, Inc.; Kennedy Valve Div.
10. Mueller Company.
11. Potter-Roemer; Fire-Protection Div.
12. United Brass Works, Inc.

B. Description: UL 668, brass or bronze, 300-psig minimum pressure rating, hose valve for connecting fire hose. Include **angle or gate** pattern design; female NPS inlet and male hose outlet; and lugged cap, gasket, and chain. Include NPS 1-1/2 or NPS 2-1/2 as indicated, and hose valve threads according to NFPA 1963 and matching local fire department threads.

1. Valve Operation: Nonadjustable type, unless pressure-regulating type is indicated.
2. Finish: Rough chrome-plated.

2.8 FIRE-DEPARTMENT CONNECTIONS

A. Exposed-Type, Fire-Department Connection:
1. Manufacturers:

    a. AFAC Inc.
    b. Elkhart Brass Mfg. Company, Inc.
    c. Fire-End & Croker Corporation.
    d. Fire Protection Products, Inc.
    e. GMR International Equipment Corporation.
    f. Guardian Fire Equipment, Inc.
    g. Tyco Fire & Building Products LP.
    h. Wilson & Cousins Inc.

2. Standard: UL 405.
3. Type: Exposed, projecting, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, wall type.
9. Outlet: Back, with pipe threads.
10. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE, or AUTO SPKR."
11. Finish: Rough brass or bronze.

B. Flush-Type, Fire-Department Connection:
1. Manufacturers:

    a. AFAC Inc.
    b. Elkhart Brass Mfg. Company, Inc.
    c. GMR International Equipment Corporation.
    d. Guardian Fire Equipment, Inc.
    e. Potter Roemer.

2. Standard: UL 405.
3. Type: Flush, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.
10. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE or AUTO SPKR."

11. Finish: Polished chrome plated.

C. Yard-Type, Fire-Department Connection:
1. Manufacturers:

a. AFAC Inc.
b. Elkhart Brass Mfg. Company, Inc.
c. Fire-End & Croker Corporation.
d. Fire Protection Products, Inc.
e. GMR International Equipment Corporation.
f. Guardian Fire Equipment, Inc.
g. Wilson & Cousins Inc.

2. Standard: UL 405.
3. Type: Exposed, freestanding.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, floor type.
9. Outlet: Bottom, with pipe threads.
10. Sleeve: Brass.
11. Sleeve Height: 18 inches.
12. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE or AUTO SPKR."
13. Finish, Including Sleeve: Rough brass or bronze.

2.9 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International.
b. Shurjoint Piping Products.
c. Tyco Fire & Building Products LP.
d. Victaulic Company.

2. Standard: UL 213.

3. Pressure Rating: 175-psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-tee and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AGF Manufacturing Inc.
   b. Reliable Automatic Sprinkler Co., Inc. (The).
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.

2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

3. Pressure Rating: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded or grooved.

C. Branch Line Testers:

1. Standard: UL 199.

2. Pressure Rating: 175 psig.
3. Body Material: Brass.
4. Size: Same as connected piping.
5. Inlet: Threaded.
6. Drain Outlet: Threaded and capped.
7. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AGF Manufacturing Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.

2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

3. Pressure Rating: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Corcoran Piping System Co.

2. Standard: UL 1474.

3. Pressure Rating: 250-psig minimum.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

F. Flexible Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. FlexHead Industries, Inc.
   b. Victaulic Company.

2. Standard: UL 1474.

3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175-psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.10 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Globe Fire Sprinkler Corporation.
2. Reliable Automatic Sprinkler Co., Inc. (The).
3. Tyco Fire & Building Products LP.
4. Victaulic Company.

B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

C. Pressure Rating for Residential Sprinklers: 175-psig maximum.

D. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

E. Pressure Rating for High-Pressure Automatic Sprinklers: 250-psig minimum.

F. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Residential Applications: UL 1626.
4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

G. Open Sprinklers with Heat-Responsive Element Removed: UL 199.

H. Sprinkler Finishes: Chrome plated, bronze and painted. Coordinate with Architect.

I. Special Coatings: Wax, and corrosion-resistant paint. Coordinate with Architect.

J. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, two piece, with 1-inch vertical adjustment.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

K. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Reliable Automatic Sprinkler Co., Inc. (The).
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.

2. Standard: UL 199.

3. Type: Wire cage with fastening device for attaching to sprinkler.

2.11 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Globe Fire Sprinkler Corporation.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.

2. Standard: UL 753.

3. Type: Mechanically operated, with Pelton wheel.
4. Alarm Gong: Cast aluminum with red-enamel factory finish.
5. Size: 8-1/2-inches diameter.
6. Components: Shaft length, bearings, and sleeve to suit wall construction.
7. Inlet: NPS 3/4.
8. Outlet: NPS 1 drain connection.

C. Electrically Operated Alarm Bell:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Fire-Lite Alarms, Inc.; a Honeywell International company.
b. Notifier.
c. Potter Electric Signal Company, LLC.

2. Standard: UL 464.

3. Type: Vibrating, metal alarm bell.
4. Finish: Red-enamel factory finish, suitable for outdoor use.
5. 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. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Potter Electric Signal Company, LLC.
b. Watts; a Watts Water Technologies company.

2. Standard: UL 346.

3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

E. Pressure Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Potter Electric Signal Company, LLC.
b. Tyco Fire & Building Products LP.

2. Standard: UL 346.

3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

F. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Fire-Lite Alarms, Inc.; a Honeywell International company.
b. Potter Electric Signal Company, LLC.

2. Standard: UL 346.

3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.
6. 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

2.12 MANUAL CONTROL STATIONS

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" for hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve.

B. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.13 CONTROL PANELS

A. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves.

1. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" when used with thermal detectors and Class A detector circuit wiring.
2. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
3. 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. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

C. Manual Control Stations: Hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

D. Panels Components:

1. Power supply.
2. Battery charger.
3. Standby batteries.
4. Field-wiring terminal strip.
5. Electrically supervised solenoid valves and polarized fire-alarm bell.
6. Lamp test facility.
7. Single-pole, double-throw auxiliary alarm contacts.
8. Rectifier.

2.14 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AGF Manufacturing Inc.
2. AMETEK, Inc.
3. Ashcroft Inc.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0- to 250-psig minimum.

E. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping" for exterior piping.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in Section 211100 "Facility Fire-Suppression Water-Service Piping." Coordinate with Civil Engineer.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 WATER-SUPPLY CONNECTIONS

A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Section 221116 "Domestic Water Piping."

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements for backflow preventers in Section 221119 "Domestic Water Piping Specialties."

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.4 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

K. Install alarm devices in piping systems.

L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.

N. Fill sprinkler system piping with water.

O. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.5 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. 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.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

N. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

O. 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.

P. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3.6 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and NFPA 13 or NFPA 13R for supports.

3.7 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. Install valves in vertical position for proper direction of flow, in main supply to system.
2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.

3.8 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.9 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Coordinate with AHJ and Civil Engineer to coordinate FDC type.

B. Install wall-type, fire-department connections.

C. Install freestanding, yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Division 03 Section "Cast-in-Place Concrete.".
   1. Install protective pipe bollards around each fire-department connection. Comply with requirements for bollards in Division 05 Section "Metal Fabrications.".

D. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.10 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.11 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

   1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
   4. Energize circuits to electrical equipment and devices.
   5. Coordinate with fire-alarm tests. Operate as required.
   6. Coordinate with fire-pump tests. Operate as required.
   7. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.12 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.13 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

3.14 PIPING SCHEDULE

A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends, cast-iron threaded fittings, and threaded grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-pressure, wet-pipe sprinkler system shall be the following:
   1. NPS 2” and smaller: Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
   2. NPS 2-1/2 and larger: Standard-weight, black-steel pipe with grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

D. Paint exposed piping. Coordinate with Architect.

3.15 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

   1. Rooms without Ceilings: Upright sprinklers.
   2. Rooms with Suspended Ceilings: Recessed sprinklers.
   3. Wall Mounting: Sidewall sprinklers.
   4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated. Coordinate with Architect.
   5. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

   1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
   2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
   3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
   4. Residential Sprinklers: Dull chrome.

5. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

C. Match finishes and paint colors with architectural elements. Request Architect for final approval on finishes

END OF SECTION 211313

SECTION 220010 – SUMMARY OF PLUMBING WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 22 Specification Sections, apply to this Section.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, and is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.

B. Contract Documents were prepared for the Project by:
Ethos Engineering,
119 West Van Buren, Suite 101
Harlingen, Texas 78550
Phone Number: (956) 230-3435

C. Scope of Work: Refer to drawings for a detailed Scope of Work.

1. Provide all materials and labor associated with new fully-operational plumbing systems for the project "Idea Academy, Robindale Campus", including but not limited to the following:

a. Plumbing fixtures and appliances such as water closets, lavatories, faucets, drinking fountains, instantaneous and storage type electric domestic water heaters, floor drains, valves, fittings, hardware and specialties.
b. Potable water distribution piping and service connections to site utilities.
c. Sanitary waste water and vent piping and service line connections to site utilities.
d. Storm water piping and service line connections to site utilities.
e. Oil/Water separator and sump pump for elevator pit discharge.
f. Grease interceptor systems, and plumbing connections to kitchen equipment and appliances
g. Painting: See Division 9 specifications. Paint all exposed piping, insulation, hangers, accessories in interior exposed areas. Paint exterior pipe supports. Coordinate paint type, color and scope of work with Architect.

1.3 ALLOWANCES

A. See Division 0 Specifications.

1.4 COORDINATION

A. All plumbing work shall be done under sub-contract to a General Contractor. Plumbing Contractor shall coordinate all work through General Contractor, who is ultimately responsible for the entire project.

B. Prior to bidding, Plumbing Contractor shall coordinate all work in Division-22 for integration with civil work, mechanical work, electrical work, irrigation work and general construction. A detailed list of inclusion and exclusions shall be provided to General Contractors at least three days prior to the end of the period set aside to request clarifications so that coordination of any missing items may be addressed and clarified by Architect/Engineer as needed.

1. Coordinate water line diameter, tap size, meter size and backflow preventer size with MEP Engineer. While meter size may be smaller, water line diameter, tap, backflow preventer sizes shall match or be larger than the connection sizes shown on Plumbing drawings. If the distance from the water mains is too large, upsize line, valve sizes to minimize pressure drops. Coordinate details with Engineer.

C. All electrical work required for operation of plumbing systems shall be coordinated through the General Contractor prior to bidding to ensure that all starters, disconnects, conduit and wiring are provided as part of the project. All components needed for a full operational installation of systems shall be provided.

D. All Building Automation Systems (BAS) required for operation of plumbing systems shall be coordinated through the General Contractor prior to bidding, to ensure that all equipment, materials, valves, sensors, devices and labor are provided as part of the project. All components needed for a full operational installation of systems shall be provided.

E. Plumbing Contractor shall coordinate and supervise installation of all controls systems, and coordinate with electrical contractors and equipment suppliers as needed. All components needed for a full operational installation of systems shall be provided.

F. Contractor shall coordinate with other divisions for power and control of plumbing systems. It is not the intent of this specification to dictate who will conduct work, only to state the requirements of conducting the work.

G. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.

H. Coordinate with Div. 1 for work sequence and optimization of construction schedule.

I. Coordinate with Div. 21 for Fire Suppression System.

J. Coordinate with Div. 23 for Mechanical System.

K. Coordinate with Div. 26 electrical contractor for providing power to plumbing equipment, and for Fire Alarm Systems interface with plumbing systems.

L. Issue written notification of the following tasks and allow five (5) days for Engineer to respond and schedule an inspection as required. Failure to issue written notification may result in work having to be redone to allow for proper inspection. It is contractor's responsibility to make sure Engineer receives notification.

1. Upon completion of underground piping installation and prior to testing or covering up.
2. Upon completion of all water piping installation and prior to insulation and/or testing.
3. Upon completion of ductwork and prior to testing and insulating.
4. Above ceiling inspections prior to ceiling tile installation.
5. When ready to request manufacturer's start-up of each piece of equipment.
6. When ready for Substantial Completion Inspection.
7. When ready for Final Inspection.

M. General

1. The Contractor shall execute all work hereinafter specified or indicated on accompanying Drawings. Contractor shall provide all equipment necessary and usually furnished in connection with such work and systems whether or not mentioned specifically herein or on the Drawings.
2. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation and thereby to provide an integrated satisfactory operating installation.
3. The Mechanical, Electrical, Plumbing, and associated Drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every pipe or conduit in its exact location. These details are subject to the requirements of standards referenced elsewhere in these specifications, and structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be organized and laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
4. When the mechanical, electrical and plumbing drawings do not give exact details as to the elevation of pipe, conduit and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with proper grades for the functioning of the system involved. Piping, exposed conduit and the duct systems are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas.

1.5 WORK SEQUENCE

A. Locate Utilities:

1. Coordinate with power, water, sewer, telephone, communications, and other utilities as well as designated Owner's personnel to locate all utilities prior to digging in any area.
2. Obtain any approvals required from utilities to relocate utilities.
3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.

B. Coordinate with Division 1 requirements to optimize construction schedule.

C. Provide equipment and material submittals, coordination drawings and shop drawings as required by specifications.

D. Submit detailed plumbing Schedule of Values with Submittals. Plumbing Submittals will not be accepted without a detailed Schedule of Values.

E. Sequence construction in coordination with work by other disciplines.

1.6 CONTRACTOR USE OF PREMISES

A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.

1. Driveways and Entrances: Keep driveways and entrances to construction site clear and available to other Contractors, Owner, and A/E personnel at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:

1. Temporary fencing around construction areas.
2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
3. Temporary fencing around equipment while site work is in progress.

1.7 SUBMITTALS

A. Manufacturer's standard dimensioned drawings, performance and product data shall be edited to delete reference to equipment, features, or information which is not applicable to the equipment being supplied for this project.

B. Provide all plumbing submittals at the same time in one or multiple bound volumes. Include originals from manufacturer. All submittals shall be in native pdf and searchable format. Faxes and copies of faxes are not acceptable.

C. Provide sufficient copies of approved data, with the engineer's approved stamp, for inclusion in the operations and maintenance manuals.

D. Provide detailed coordination drawings showing how plumbing system components will be installed in coordination with work by others. Engineer’s drawing files will be made available to Contractor for producing coordination and as-built drawings upon request.

1.8 SCHEDULE OF VALUES -Special Requirements

A. Plumbing Contractor shall submit a Schedule of Values reflecting the total value of Plumbing Work in the Contract, and broken down into the following items as a minimum, with a line-item for Materials/Equipment and another for Labor:

1. Plumbing fixtures and equipment
2. Plumbing materials
3. Plumbing labor
4. Allowances.
5. Miscellaneous
6. Administrative and project management.

B. Schedule of Values shall be included with bound submittals. Submittals without a Schedule of Values shall not be reviewed.

1.9 EQUIPMENT MANUFACTURERS

A. Plumbing design is based on equipment and materials scheduled and specified. These are used as the basis for performance characteristics, quality, and physical dimensions/weight.

B. Equipment and materials by other APPROVED manufacturers may be provided by Contractor. In doing so, Contractor assumes responsibility for the performance, quality, and physical dimensions of the proposed units.

C. Any costs associated with modifications to the design due to submittal of equipment and/or materials other than those used as the basis of design are the Contractor's responsibility. This includes any design time, production of drawings, and time delays.

D. Where use of equipment and/or materials other than those used as the basis of design impact other disciplines, Contractor shall assume responsibility for all costs associated with any APPROVED modifications. This may include resizing of electrical circuits, modifying openings in the structure, relocating floor drains, etc.

1.10 OPERATIONS AND MAINTENANCE MANUALS & TRAINING

A. Submit Operations and Maintenance Manuals two weeks prior to Substantial Completion Inspection. Engineer will not conduct a Substantial Completion Inspection without having reviewed Operations and Maintenance Manuals.

B. Use Operations and Maintenance Manuals as a guide for conducting training of Owner's personnel.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 220010

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. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers:

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:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, 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: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers:

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. 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.

2. 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: Cast-iron wall sleeves

2. Exterior Concrete Walls below Grade: Cast-iron wall sleeves with sleeve-seal system.
   a. 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: Cast-iron wall sleeves with sleeve-seal system.
   a. 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: Galvanized-steel-pipe sleeves

5. Interior Partitions: Galvanized-steel-pipe 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-plated and rough-brass finish 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-plated and rough-brass finish and with concealed hinge and setscrew.

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. Insulated Piping: One-piece, stamped-steel type.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
f. Bare Piping in Equipment Rooms: One-piece, cast-brass type with rough-brass finish.

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.
2. Existing Piping: Split-casting, 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 220519 – METERS AND GAUGES 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. Liquid-in-glass thermometers.
   2. Thermowells.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Certificates: For each type of meter and gauge, from manufacturer.

C. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
   1. Manufacturers:
      a. Trerice, H. O. Co.
      b. Weiss Instruments, Inc.
      c. Winters Instruments - U.S.

   2. Standard: ASME B40.200.

   3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
   4. Case Form: Adjustable angle unless otherwise indicated.
   5. Tube: Glass with magnifying lens and blue or red organic liquid.
   6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
   7. Window: Glass.
   8. Stem: Aluminum and of length to suit installation.

      a. Design for Air-Duct Installation: With ventilated shroud.
      b. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: brass.
4. Material for Use with Steel Piping: stainless steel.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. Bore: Diameter required to match thermometer bulb or stem.
7. Insertion Length: Length required to match thermometer bulb or stem.
8. Lagging Extension: Include on thermowells for insulated piping and tubing.
9. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 TEST PLUGS

A. Manufacturers

1. Flow Design, Inc.
2. Trerice, H. O. Co.
3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
4. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS ¼or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.4 TEST-PLUG KITS

A. Manufacturers:

1. Flow Design, Inc.
2. Trerice, H. O. Co.
3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
4. Weiss Instruments, Inc.

B. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gauge and adapter, and carrying case. Thermometer sensing elements, pressure gauge, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.

D. Pressure Gauge: Small, Bourdon-tube insertion type with 2- to 3-inch-diameter dial and probe. Dial range shall be at least 0 to 200 psig.

E. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install test plugs in piping tees.

G. Install thermometers in the following locations:
   1. Inlets and outlets of each domestic water heater.

3.2 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance of meters, gauges, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gauges to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
   1. Industrial-style, liquid-in-glass type.
   2. Test plug with EPDM self-sealing rubber inserts.

B. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Hot-Water Piping: 0 to 200 deg F.

END OF SECTION 22 05 19

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 gate valves.
   3. Bronze globe valves.

B. Related Sections:

   1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
   2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

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.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

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 B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
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 angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. 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. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller.

4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.

E. Valves in Insulated Piping: With 2-inchstem 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.

F. Valve-End Connections:
1. Solder Joint: With sockets according to ASME B16.18.
2. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers:
   a. NIBCO INC.
   b. Watts Industries, Inc.; Water Products Div.
   c. Kitz Corporation
   d. Apollo

2. Description:

   a. Standard: MSS SP-110.
   b. CWP Rating: 400 psig.
   c. Body Design: One piece.
   d. Body Material: Bronze.
   e. Ends: Threaded.
   f. Seats: PTFE or TFE.
   g. Stem: Bronze.
   h. Ball: Chrome-plated brass.
   i. Port: Reduced.

2.3 BRONZE GATE VALVES

A. Class 150, Bronze Gate Valves:

1. Manufacturers:
   a. NIBCO INC.
   b. Hammond Valve.
   c. Kitz Corporation.
   d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   e. Apollo

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron**, bronze, or aluminum**.

2.4 BRONZE GLOBE VALVES

A. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers:
a. Hammond Valve.
b. Milwaukee Valve Company.
c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
d. Kitz Corporation.
e. Apollo

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: PTFE or TFE.
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.

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, or plug valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service: Globe or ball valves.

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 2and 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 5and Larger: Flanged ends.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: One piece, regular port, bronze with bronze trim.
3. Bronze Gate Valves: Class 150.

4. Bronze Globe Valves: Class 150, bronze, nonmetallic disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves: Class 150.
3. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, stainless-steel disc.
4. Iron Gate Valves: Class 250.
5. Iron Globe Valves: Class 250.

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. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe stands.
6. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

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 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. 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. Fiberglass strut systems.
4. Pipe stands.
5. 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.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "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.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated 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:

    a. Allied Tube & Conduit.
    b. Cooper B-Line, Inc.
    c. Flex-Strut Inc.
    d. GS Metals 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.
8. Plastic Coating: PVC.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers:

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, 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. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

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 or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. 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: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.

4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. 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. 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 Section 077200 "Roof Accessories" for curbs.

G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

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 and seismic 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 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.

L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. 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.

N. 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.
d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24: 24 inches long and 0.105 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 Section 099113 "Exterior Painting." Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

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 carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. 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. 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.
3. 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.
4. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
5. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
6. 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.

K. 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.

L. 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. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. 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. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. 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.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220548.13 - VIBRATION CONTROLS 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. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Elastomeric hangers.
5. Spring hangers.

B. Related Requirements:

1. Section 210548.13 "Vibration Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 230548.13 "Vibration Controls for HVAC" for devices for HVAC equipment and systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

C. Delegated-Design Submittal: For each vibration isolation device.

1. Include design calculations for selecting vibration isolators.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

B. Elastomeric Isolation Pads:
1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
2. Size: Factory or field cut to match requirements of supported equipment.
3. Pad Material: Oil and water resistant with elastomeric properties.
4. Surface Pattern: Ribbed, Waffle, non-slip pattern.
5. Infused nonwoven cotton or synthetic fibers.
6. Load-bearing metal plates adhered to pads.
7. Sandwich-Core Material: Resilient and elastomeric.

C. Double-Deflection, Elastomeric Isolation Mounts:
1. Mounting Plates:

a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

D. Restrained Elastomeric Isolation Mounts:
1. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

a. Housing: Cast-ductile iron or welded steel.
b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

E. Freestanding, Laterally Stable, Open-Spring Isolators:
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

F. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.

a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
b. Top housing with threaded mounting holes and internal leveling device, elastomeric pad.

G. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

H. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.2 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. 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 seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static within specified loading limits.

3.3 VIBRATION CONTROL DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

END OF SECTION 220548.13

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. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. 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 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: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters 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. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
5. Fasteners: Stainless-steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

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. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

D. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

E. Fasteners: Stainless-steel rivets or self-tapping screws.

F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

G. 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; also include 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 1/2 inch.

2.4 STENCILS

A. Stencils for Piping:

1. Lettering Size: Size letters according to ASME A13.1 for piping.
2. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 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. Paint may be in pressurized spray-can form.

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 minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass beaded chain.

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. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety 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 GENERAL INSTALLATION REQUIREMENTS

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.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting." and Section 099600 "High-Performance Coatings."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, 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. Pipe Label Locations: 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. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

3.5 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.

3.6 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. Domestic chilled-water piping for drinking fountains.
   5. Storm water piping.
   6. Supplies and drains for handicap-accessible lavatories and sinks.

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, equipment connections, and access panels.
   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 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.

1.6 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 220529 "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.

1.8 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:
      a. Armaflex
      b. K-Flex

G. Mineral-Fiber, Preformed Pipe Insulation:
   1. Products:
      a. Johns Manville; Micro-Lok.
      b. Knauf Insulation; 1000(Pipe Insulation.
      c. 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.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
   1. Products:
      a. Insulco, Division of MFS, Inc.; Triple I.
      b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

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 and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
   1. Products:

a. Foster Products Corporation, H. B. Fuller Company
b. Aeroflex
c. Armacell
d. K-Flex

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."

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products:
a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 80 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. 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:
a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.
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."

2.4 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 use on below-ambient services.
1. Products:
a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.

e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.

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 SEALANTS

A. Joint Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
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).
6. Sealants 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. FSK and Metal Jacket Flashing Sealants:
1. Products:
a. Childers Products, Division of ITW; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.
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).
7. Sealants 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. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products:
a. Childers Products, Division of ITW; 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, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants 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."

2.6 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.

2.8 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Metal Jacket:

   1. Products:
      a. Childers Products, Division of ITW; Metal Jacketing Systems.
      b. PABCO Metals Corporation; Surefit.
      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: 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.

C. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Products:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
      b. Compac Corp.; 104 and 105.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
      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. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Products:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
      b. Compac Corp.; 110 and 111.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
      d. Venture Tape; 1525 CW, 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.

2.11 SECUREMENTS

A. Bands:
   1. Products:
      a. Childers Products; Bands.
      b. PABCO Metals Corporation; Bands.
      c. RPR Products, Inc.; Bands.

   2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015 inch thick, 3/4 inch wide.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy.

See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers. Retain subparagraph and list of manufacturers below. See Section 016000 "Product Requirements."

1. Manufacturers:
    a. C & F Wire.
    b. Childers Products.
    c. PABCO Metals Corporation.
    d. RPR Products, Inc.

2.12 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:
    1. 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.

B. Protective Shielding Piping Enclosures:
    1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with 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 prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
    1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

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 4 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 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 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 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.

3.8 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.

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.

3.9 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
   1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
      a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.10 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.

3.11 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

C. Domestic hot-water storage tank insulation shall be the following, of thickness to provide an R-value of 13: Mineral-fiber pipe and tank.

3.12 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.

3.13 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water Piping embedded in walls:
1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1 inch thick, with two coats of protective coating recommended by the insulation manufacturer.

B. Domestic Hot and Recirculated Hot Water:
1. Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick, with two coats of protective coating recommended by the insulation manufacturer.

C. 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, with two coats of protective coating recommended by the insulation manufacturer.

D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1 inch thick.

E. 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. Flexible Elastomeric: 1 inch thick.

F. Hot Service Drains:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

G. Hot Service Vents:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

H. Rainwater conductors, and roof drain bodies:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Flexible Elastomeric: 1 inch thick, with two coats of protective coating recommended by the insulation manufacturer.

I. Vapor barrier on all piping, except on hot water piping.

J. Insulation shall be painted where exposed to view. Coordinate with Architect.

3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Flexible Elastomeric: 1 inch thick.
      b. Vapor barrier.

3.15 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. Piping, Exposed:
   1. Aluminum, Smooth: 0.020 inch thick.

3.16 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.

B. Related Requirements:

1. Section 221113 "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

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 no fewer than two 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 Annex G. 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. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

E. 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.

F. 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.

G. Copper Push-on-Joint Fittings:
1. Description:

a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
b. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

H. Copper-Tube, Extruded-Tee Connections:
1. Description: Tee formed in copper tube according to ASTM F 2014.

2.3 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. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: tube.

2.5 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.

1. Manufacturers:

a. Cascade Waterworks Manufacturing.
b. Dresser, Inc.; Dresser Piping Specialties.
c. Ford Meter Box Company, Inc. (The).
d. JCM Industries.
e. Romac Industries, Inc.
f. Smith-Blair, Inc; a Sensus company.
g. Viking Johnson; c/o Mueller Co.

D. Plastic-to-Metal Transition Unions:

1. Manufacturers:

a. Charlotte Pipe and Foundry Company.
b. Harvel Plastics, Inc.
c. Spears Manufacturing Company.

2. Description:

a. PVC four-part union.
b. Brass threaded end.
c. Solvent-cement-joint plastic end.
d. Rubber O-ring.
e. Union nut.

2.6 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. Manufacturers:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. EPCO Sales, Inc.
d. Hart Industries International, Inc.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
f. Zurn Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1079.
3. Pressure Rating: 150 psig.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. EPCO Sales, Inc.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 150 psig.
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Nonconducting materials for field assembly of companion flanges.
3. Pressure Rating: 150 psig.
4. Gasket: Neoprene or phenolic.

5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers:

a. Perfection Corporation; a subsidiary of American Meter Company.
b. Precision Plumbing Products, Inc.
c. Victaulic Company.
2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

2.7 FLEXIBLE CONNECTORS

A. Manufacturers:

1. Flex-Hose Co., Inc.
2. Flex Pression, Ltd.
3. Flex-Weld, Inc.
4. Hyspan Precision Products, Inc.
5. Metraflex, Inc.
6. Universal Metal Hose; a Hyspan company

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 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 ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

E. 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."

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

H. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

K. 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.

L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

M. Install piping to permit valve servicing.

N. 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.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install PEX piping with loop at each change of direction of more than 90 degrees.

R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

S. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump.

T. Install thermostats in hot-water circulation piping.

U. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

V. 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."

W. 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."

X. 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. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

F. 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.

G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."

1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.5 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 or unions.

3.6 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.7 FLEXIBLE CONNECTOR INSTALLATION

A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.

B. Install bronze-hose flexible connectors in copper domestic water tubing.

C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.8 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. 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.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

E. 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.
7. NPS 8: 10 feet with 3/4-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.9 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.

3.10 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.

3.11 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 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.

3.12 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.

3.13 CLEANING

A. Clean and disinfect 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.

3.14 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, up to NPS 8 and larger, shall be the following:

1. Soft copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.

E. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
1. Hard copper tube, ASTM B 88, Type L; copper, solder-joint fittings; and brazed joints.
2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

F. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; copper, solder-joint fittings; and brazed joints.
2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
3. Hard copper tube, ASTM B 88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.

G. Aboveground, combined domestic water-service and fire-service-main piping, NPS 6 to NPS 12, shall be the following:

1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

3.15 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 butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
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. Backflow preventers.
2. Outlet boxes.
3. Wall hydrants.
4. Water-hammer arresters.
5. Trap-seal primer valves.
6. Trap-seal primer systems.
7. Flexible connectors.

B. Related Requirements:

1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 223200 "Domestic Water Filtration Equipment" for water filters in domestic water piping.
4. Section 224300 "Medical Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.
5. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
6. Section 224713 "Drinking Fountains" for water filters for water coolers.
7. Section 224716 "Pressure Water Coolers" for water filters for water coolers.
8. Section 224723 "Remote Water Coolers" 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 Annex G [**and NSF 14**].[**Mark "NSF-pw" on plastic piping components.**]

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: [**125 psig (860 kPa)**] unless otherwise indicated.

2.3 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

B. Manufacturers:
1. Zurn
2. Wilkins
3. Or Approved Equal.

C. Description:

1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: [**12 psig (83 kPa)]**
4. Size: see drawings.
5. Body: Bronze for NPS 2 (DN 50) and smalle
6. End Connections: Threaded for NPS 2 (DN 50) and smaller.
7. Configuration: Designed for [**horizontal, straight-through**] flow.
8. Accessories:

    a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 (DN 65) 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.

2.4 OUTLET BOXES

A. Icemaker Outlet Boxes:

1. Manufacturers:
   a. Guy Gray
   b. Zurn
   c. Moen

2. Description: See schedule.

2.5 WALL HYDRANTS

1. Manufacturers:
   a. Zurn
   b. Woodford
   c. Or Approved Equal

2. Description: See schedule.

2.6 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers:
   a. Zurn.
   b. Mifab.
   c. Wade.
   d. Or “Approved equal”.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: [Stainless Steel **Metal bellows**].
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.7 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers:
   a. PPP or Approved Equal
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig (860 kPa) minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.8 FLEXIBLE CONNECTORS

A. 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 (1380 kPa)**].
2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 (DN 65) 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 outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

C. Install water-hammer arresters in water piping according to PDI-WH 201.

D. 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. Outlet boxes.

3. 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 [**reduced-pressure-principle backflow preventer**] [**double-check, backflow-prevention assembly**] [**and**] [**double-check, detector-assembly backflow preventer**] 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.

END OF SECTION 221119

SECTION 221123.13 - DOMESTIC-WATER PACKAGED BOOSTER 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. Multiplex, constant-speed booster pumps.
   2. Multiplex, variable-speed booster pumps.

B. Related Sections:

   1. Section 221123 "Domestic Water Pumps" for domestic-water circulation pumps.
   2. Section 221223 "Facility Indoor Potable-Water Storage Tanks" for separate hydropneumatic domestic-water tanks for multiplex booster pumps.

1.3 DEFINITIONS

A. VFC: Variable-frequency controller(s).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, and dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For booster pumps. 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 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For booster pumps 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. ASME Compliance: Comply with ASME B31.9 for piping.

C. UL Compliance for Packaged Pumping Systems:

1. UL 508, "Industrial Control Equipment."
2. UL 508A, "Industrial Control Panels."
3. UL 778, "Motor-Operated Water Pumps."
4. UL 1995, "Heating and Cooling Equipment."

D. Booster pumps shall be listed and labeled as packaged pumping systems by testing agency acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Retain protective coatings and flange's protective covers during storage.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 MULTIPLEX, VARIABLE-SPEED BOOSTER PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong Pumps, Inc.
2. Bell & Gossett; a Xylem brand.
3. Goulds Water Technology; a Xylem brand.
4. Grundfos Pumps Corporation U.S.A.
5. ITT Flowtronex.

B. Description: Factory-assembled and -tested, fluid-handling system for domestic water, with pumps, piping, valves, specialties, and controls, and mounted on base.

C. Pumps:

1. Type: End suction as defined in HI 1.1-1.2 and HI 1.3 for end-suction, close-coupled, single-stage, overhung-impeller, centrifugal pump.
2. Casing: Radially split; stainless steel.
3. Impeller: Closed, stainless steel; statically and dynamically balanced and keyed to shaft.
4. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve and deflector.

5. Seal: Mechanical.
6. Orientation: Mounted horizontally.

D. Motors: Single speed, TEFC, ball-type bearings. Select motors that will not overload through full range of pump performance curve.

E. Piping: Copper tube and copper fittings.

F. Valves:

1. Shutoff Valves NPS 2 and Smaller: Gate valve or two-piece, full-port ball valve, in each pump's suction and discharge piping.
2. Shutoff Valves NPS 2-1/2 and Larger: Gate valve, in each pump's suction and discharge piping and in inlet and outlet headers.
3. Check Valves: Silent type in each pump's discharge piping.
4. Thermal-Relief Valve: Temperature-and-pressure relief type in pump's discharge header piping.

G. Dielectric Fittings: With insulating material isolating joined dissimilar metals.

H. Control Panel: Factory installed and connected as an integral part of booster pump; automatic for multiple-pump, variable-speed operation, with load control and protection functions.

1. Control Logic: Solid-state system with transducers, programmable microprocessor, VFC, and other devices in controller. Install VFC for pump motors larger than 25 hp in separate panel; same type as motor control panel enclosure.
2. Motor Controller: NEMA ICS 2, variable-frequency, solid-state type.

3. Enclosure: NEMA 250, Type 1.
4. Motor Overload Protection: Overload relay in each phase.
5. Starting Devices: Hand-off-automatic selector switch for each pump in cover of control panel, plus pilot device for automatic control.

    a. Duplex, Automatic, Alternating Starter: Switches lead pump to lag main pump and to two-pump operation.

6. Pump Operation and Sequencing: The system shall start upon drop in system pressure and will regulate pump speed to maintain constant pressure under variable flow conditions. The system will stop upon detection of no-flow.

7. VFC: Voltage-source, pulse-width, modulating-frequency converter for each pump.
8. Manual Bypass: Magnetic contactor arranged to transfer to constant-speed operation upon VFC failure.
9. Instrumentation: Suction and discharge pressure gages.
10. Lights: Running light for each pump.
11. Alarm Signal Device: Sounds alarm when backup pumps are operating.
12. Thermal-bleed cutoff.
13. Low-suction-pressure cutout.
14. Low-discharge-pressure cutout.

I. Base: Structural steel.

J. Capacities and Characteristics: See schedules

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.

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. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in NFPA 70.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for booster pumps to verify actual locations of piping connections before booster-pump installation.

3.2 INSTALLATION

A. Equipment Mounting:

1. Install booster pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment"
3. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

B. Support connected domestic-water piping so weight of piping is not supported by booster pumps.

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. Connect domestic-water piping to booster pumps. Install suction and discharge pipe equal to or greater than size of system suction and discharge headers.

1. Install shutoff valves on piping connections to booster-pump suction and discharge headers. Install ball, butterfly, or gate valves same size as suction and discharge headers. Comply with requirements for general-duty valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

2. Install union, flanged, or grooved-joint connections on suction and discharge headers at connection to domestic-water piping. Comply with requirements for unions and flanges specified in Section 221116 "Domestic Water Piping."
3. Install valved bypass, same size as and between piping, at connections to booster-pump suction and discharge headers. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."
4. Install flexible connectors, same size as piping, on piping connections to booster-pump suction and discharge headers. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."
5. Install piping adjacent to booster pumps to allow service and maintenance.

3.4 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 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.

B. Tests and Inspections:

1. Perform visual and mechanical inspection.
2. Leak Test: After installation, charge booster pump and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start booster pumps to confirm proper motor rotation and booster-pump operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Pumps and controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 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.

3.7 ADJUSTING

A. Adjust booster pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust pressure set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting booster pump to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain booster pumps.

END OF SECTION 221123.13

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 221313 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.

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.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For sovent drainage system. Include plans, elevations, sections, and details.

1.5 INFORMATIONAL SUBMITTALS

A. 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 no fewer than two 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 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.

C. Heavy-Duty, Hubless-Piping Couplings:

a. Manufacturers:

1) ANACO.
2) Clamp-All Corp.
3) Ideal Div.; Stant Corp.
4) Mission Rubber Co.
5) Tyler Pipe; Soil Pipe Div.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 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."

2.4 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. 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.

4. 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: Stainless steel.
   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.

2.5 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 674 or AWWA C105/A 21.5.

B. Material: high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.

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 PVC piping according to ASTM D 2665.

O. Install underground PVC piping according to ASTM D 2321.

P. 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. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

Q. 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."

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

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. 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.

B. 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. 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 unions.
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 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. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. 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.

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 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.

3.6 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. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
6. 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.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 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.

3.9 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.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

A. Underground and above ground (unless noted otherwise), soil, waste, and vent piping shall be the following:
   1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
   2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

B. In Return Air Plenum: Soil, waste, and vent piping shall be the following:
   1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.

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.
   7. Oil interceptors.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:

   1. Oil interceptors.

B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.

   1. Wiring Diagrams: Power, signal, and control wiring.

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 roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Metal Floor Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts: see detail on plans.
2. Standard: ASME A112.36.2M for [**cast-iron soil pipe with cast-iron ferrule**] [**threaded, adjustable housing**] cleanout.
3. Size: Same as connected branch.
4. Type: [**Threaded, adjustable housing**].
5. Body or Ferrule: [**Cast iron**].
6. Clamping Device: [**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: [**Nickel-bronze, copper alloy**]
11. Frame and Cover Shape: [**Round**].
12. Top Loading Classification: [**Medium**] Duty.

B. Plastic Wall Cleanouts:

1. See detail on plans.
2. Size: Same as connected branch.
3. Body: PVC.

4. Closure Plug: Stainless Steel.
5. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.2 FLOOR DRAINS

A. Manufacturers:

1. Zurn.
2. Mifab.
3. Josam.
4. Wade.
5. Watts.

B. Description: See schedules.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Description: Manufactured assembly made of [**6.0-lb/sq. ft. (30-kg/sq. m)**, **0.0938-inch-(2.4-mm-)**] thick, lead flashing collar and skirt extending at least [**6 inches (150 mm)**] from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

    a. Open-Top Vent Cap: Without cap.
    b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
    c. 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. 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 (DN 15) side inlet.

B. 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.

C. 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 (25 mm)**] [**2 inches (51 mm)**] <**Insert dimension**> 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.

D. 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.

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. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) 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. (3.7 kg/sq. m or 0.41-mm thickness).
2. Vent Pipe Flashing: 8 oz./sq. ft. (2.5 kg/sq. m or 0.27-mm thickness).

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness, unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) 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.

2.7 OIL INTERCEPTORS

A. Oil Interceptors:

1. Description: See Schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. 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 (DN 100). Use NPS 4 (DN 100) 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 (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
4. Locate at base of each vertical soil and waste stack.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. 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. Coordinate with Structural Drawings prior installation.
b. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
c. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
d. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) 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.

E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

G. Install through-penetration firestop assemblies in plastic [**conductors**] [**and**] [**stacks**] at floor penetrations.

H. Assemble open drain fittings and install with top of hub [**1 inch (25 mm)**] [**2 inches (51 mm)**] 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 oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.

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. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. 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. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) 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 (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) 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 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Oil interceptors.

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."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled **[Oil Separator]** and its installation, including piping and electrical connections, and to assist in testing.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 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.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain **[Oil Separator]**. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 221319

SECTION 221323 - SANITARY WASTE INTERCEPTORS

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. Grease interceptors.
   2. Oil interceptors.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

B. PP: Polypropylene plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of interceptor indicated. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.

B. Shop Drawings: For each type and size of precast-concrete interceptor indicated.
   1. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Interceptors, 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. Interceptors.
   2. Piping connections. Include size, location, and elevation of each.
   3. Interface with underground structures and utility services.

PART 2 - PRODUCTS

2.1 GREASE INTERCEPTORS

A. Grease Interceptors: Precast concrete complying with ASTM C 913.

1. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
2. Structural Design Loads:
   a. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
3. Resilient Pipe Connectors: ASTM C 923, cast or fitted into interceptor walls, for each pipe connection.
4. Steps: ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of interceptor to finished grade is less than 60 inches.
5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
6. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover.
   a. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
   b. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
   c. Include indented top design with lettering cast into cover, using wording equivalent to "GREASE INTERCEPTOR."

B. Capacities and Characteristics: See Drawing Schedules.

2.2 OIL INTERCEPTORS

A. Oil Interceptors: Precast concrete comply with ASTM C 913.
1. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
2. Structural Design Loads:
   a. Medium-Traffic Load: Comply with ASTM C 890, A-12 (ASSHTO HS15-44).
3. Resilient Pipe Connectors: ASTM C 923, cast or fitted into interceptor walls, for each pipe connection.
4. Steps: ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of interceptor to finished grade is less than 60 inches.
5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
6. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover.
   a. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
   b. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
   c. Include indented top design with lettering cast into cover, using wording equivalent to "OIL INTERCEPTOR."

B. Capacities and Characteristics: See Drawing Schedules.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 INSTALLATION

A. Install precast-concrete interceptors according to ASTM C 891. Set level and plumb.

B. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.

C. Set tops of manhole frames and covers flush with finished surface in pavements. Set tops 3 inches above finish surface elsewhere, unless otherwise indicated.

D. Set tops of grating frames and grates flush with finished surface.

E. Set interceptors level and plumb.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Make piping connections between interceptors and piping systems.

3.4 IDENTIFICATION

A. Identification materials and installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.
   1. Use warning tapes or detectable warning tape over ferrous piping.
   2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

END OF SECTION 221323

SECTION 221413 – FACILITY STORM DRAINAGE 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. This Section includes the following storm drainage piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.
3. Encasement for underground metal piping.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:

1. Storm Drainage Piping: **20-foot head of water**

1.4 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Field quality-control inspection and test reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

a. Manufacturers:

1) ANACO.
2) Clamp-All Corp.
3) Ideal Div.; Stant Corp.
4) Mission Rubber Co.
5) Tyler Pipe; Soil Pipe Div.

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

2.5 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Sleeve Materials:

a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Flexible Ball Joints: Ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed ball-joint section and ductile-iron gland, rubber gasket, and steel bolts.

E. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

2.6 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Description: ASTM A 674 or AWWA C105, **high-density, crosslaminated PE film of 0.004-inch** minimum thickness.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Underground and above ground storm drainage piping **NPS 8 and smaller (UNO)** shall be the following:
   1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
   2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

C. In Return Air Plenum: Storm drainage piping **NPS 8 and smaller** shall be the following:
   1. Hubless cast-iron soil pipe and fittings; **heavy-duty** shielded, stainless-steel couplings; and coupled joints.

3.3 PIPING INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Utility Drainage Piping."

B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Storm Drainage Piping Specialties."

D. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

E. Install underground, steel, force-main piping. **Install encasement on piping according to ASTM A 674 or AWWA C105.**

F. 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.

G. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

H. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

I. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. 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.

J. Lay buried building storm 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.

K. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:

1. Building Storm Drain: 1 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 Storm-Drainage Piping: 2 percent downward in direction of flow.

L. Install force mains at elevations indicated.

M. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

    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. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 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: 60 inches with 3/4-inch rod.
5. NPS 8 to 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: 48 inches with 3/4-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.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

3.7 INSULATION

A. Refer to Plumbing Insulation specification Section 220700.

B. Service: Rainwater conductors, and roof drain bodies.
1. Operating Temperature: 32 to 100 deg F
2. Insulation Material: Flexible elastomeric.
3. Insulation Thickness: 1” thick.
4. Field-Applied Jacket: ASJ.
5. Vapor Retarder Required: Yes.
6. Finish: Painted (Coordinate with Architect).

3.8 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.
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 storm drainage 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 storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage 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. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.9 CLEANING

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.

3.10 PROTECTION

A. Exposed **PVC** Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 221413

SECTION 221423 - STORM DRAINAGE 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. Miscellaneous storm drainage piping specialties.
   2. Cleanouts.
   3. Flashing materials.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 ROOF DRAINS

A. See schedules:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company.
      b. MIFAB, Inc.
      c. Zurn Plumbing Products Group; Specification Drainage Operation.

2.2 CLEANOUTS

A. Floor Cleanouts: See schedules
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company; Josam Div.
      b. MIFAB, Inc.
      c. Zurn Plumbing Products Group; Light Commercial Operation.

B. Test Tees:
1. Manufacturers:
a. Josam Company.
b. MIFAB, Inc.
c. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure Plug: **Countersunk brass**.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

C. Wall Cleanouts:
1. Manufacturers:
a. Josam Company.
b. MIFAB, Inc.
c. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
3. Size: Same as connected drainage piping.
4. Body Material: **Hubless, cast-iron soil-pipe test tee** as required to match connected piping.
5. Closure: **Countersunk**, **drilled-and-threaded**, **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.

2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers:
a. ProSet Systems Inc.

2. Standard: ASTM E 814, for through-penetration firestop assemblies.
3. Certification and Listing: **Insert testing agency acceptable to authorities having jurisdiction** for through-penetration firestop assemblies.
4. Size: Same as connected pipe.
5. 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.
6. 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.
7. Special Coating: Corrosion resistant on interior of fittings.

2.4 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft..

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, 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.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07 Sections.
1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.

B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.

C. Install downspout boots at grade with top **12 inches** above grade. Secure to building wall.

D. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

E. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate cleanouts at base of each vertical soil and waste stack.

F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

H. Install test tees in vertical conductors and near floor.

I. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

J. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.

K. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
   1. 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 the pipe size, with a minimum length of 10 inches and with 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. 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 221423

SECTION 223300 - 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. Commercial, electric, storage, domestic-water heaters.
   2. Flow-control, electric, tankless, domestic-water heaters.
   3. 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 and tankless, 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. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "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. Failures include, but are not limited to, the following:

    a. Structural failures including storage tank and supports.
    b. Faulty operation of controls.
    c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

    a. Commercial, Electric, Domestic-Water Booster Heaters:

        1) Controls and Other Components: Five years.

    b. Commercial, Electric, Storage, Domestic-Water Heaters:

        1) Storage Tank: Ten years.
        2) Controls and Other Components: Five years.

    c. Electric, Tankless, Domestic-Water Heaters: Five year(s).
    d. Compression Tanks: Ten years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Commercial, Electric, Domestic-Water Heaters:

1. Commercial, Storage, Electric Water Heaters:
   a. Bradford White Co.
   b. State Industries.

2. Standard: UL 1453.
3. Tank Construction: ASME-code steel with 150-psig working-pressure rating..

   a. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, pressure gage, thermometer, drain, anode rod, and controls as required. Attach tappings to tank before testing and labeling. ASME B1.20.1 pipe thread.
   b. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
   c. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
   d. Jacket: Steel, with enameled finish.

4. Factory-Installed Tank Appurtenances:

   a. Anode Rod: Replaceable magnesium.
   b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
   c. Insulation: Comply with ASHRAE/IESNA 90.1.
   d. Jacket: Steel with enameled finish.
   e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
   f. Temperature Control: Adjustable thermostat.
   g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
   h. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valve. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
   i. Gages: Combination temperature-and-pressure type or separate thermometer and pressure gage.

5. Special Requirements: NSF 5 construction.

6. Capacity and Characteristics: See Drawings

2.2 ELECTRIC, TANKLESS, DOMESTIC-WATER HEATERS

A. Flow-Control, Electric, Tankless, Domestic-Water Heaters:

1. Manufacturers:

    a. Controlled Energy Corporation.
    b. Chronomite Laboratories, Inc.
    c. Eemax.
2. Standard: UL 499 for electric, tankless, (domestic-water heater) heating appliance.
3. Construction: Copper piping or tubing complying with NSF 61 Annex G barrier materials for potable water, without storage capacity.

    a. Connections: ASME B1.20.1 pipe thread.
    b. Pressure Rating: 150 psig.
    c. Heating Element: Resistance heating system.
    d. Temperature Control: Flow-control fitting.
    e. Safety Control: High-temperature-limit cutoff device or system.
    f. Jacket: Aluminum or steel with enameled finish or plastic.

4. Support: Bracket for wall mounting.
5. Capacity and Characteristics: See drawings.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. AMTROL Inc.
    b. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
    c. State Industries.
    d. Taco, Inc.
2. 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.
3. 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 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
    c. Air-Charging Valve: Factory installed.

4. Capacity and Characteristics: See drawings.

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.

E. Manifold Kits: Domestic-water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and calibrated balancing valves to provide balanced flow through each domestic-water heater.

1. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
2. Comply with requirements for balancing valves specified in Section 221119 "Domestic Water Piping Specialties."

F. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig-maximum outlet pressure unless otherwise indicated.

G. 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.

H. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.

I. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

J. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

K. 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 above the floor.

L. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. 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.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."

1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
2. Maintain manufacturer's recommended clearances.
3. Arrange units so controls and devices that require servicing are accessible.
4. 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.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.
8. Anchor domestic-water heaters to substrate.

B. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters at least 18 inches above floor on wall bracket.

1. Maintain manufacturer's recommended clearances.
2. Arrange units so controls and devices that require servicing are accessible.
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 supported equipment.
5. Anchor domestic-water heaters to substrate.

C. 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 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

D. Install commercial, electric, domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

E. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. 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.

F. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-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.

G. 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."

H. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers.

I. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves and thermometers.

J. 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."

K. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

L. Fill electric, domestic-water heaters with water.

M. 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.

C. Connect hot- and cold-water piping with shutoff valves and unions.

D. Make connections with dielectric fittings where piping is made of dissimilar metal.

E. Electrical Connections: Power wiring and disconnect switches are specified in Division 16 Sections. Arrange wiring to allow unit service.

F. Ground equipment.

1. 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.

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 commercial and tankless, electric, domestic-water heaters.

END OF SECTION 223300

SECTION 224000 - 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. This Section includes the following conventional plumbing fixtures and related components:

1. Faucets for lavatories and sinks.
2. Flushometers.
3. Toilet seats.
4. Protective shielding guards.
5. Fixture supports.
6. Water closets.
7. Urinals
8. Lavatories.
9. Kitchen sinks.
10. Service basins.

B. Related Sections include the following:

1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
3. Division 22 Section "Drinking Fountains and Water Coolers."
4. Division 31 Section "Facility Water Distribution Piping" for exterior plumbing fixtures and hydrants.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. FRP: Fiberglass-reinforced plastic.

G. PMMA: Polymethyl methacrylate (acrylic) plastic.

H. PVC: Polyvinyl chloride plastic.

I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

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. Regulatory Requirements: Comply with requirements in ICC 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.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
3. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
4. Vitreous-China Fixtures: ASME A112.19.2M.
5. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
6. Water-Closet, Flushometer Tank Trim: ASSE 1037.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
4. Faucets: ASME A112.18.1.
5. Hose-Connection Vacuum Breakers: ASSE 1011.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
8. NSF Potable-Water Materials: NSF 61.
9. Pipe Threads: ASME B1.20.1.
10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
11. Supply Fittings: ASME A112.18.1.
12. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Dishwasher Air-Gap Fittings: ASSE 1021.
4. Plastic Tubular Fittings: ASTM F 409.
5. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Flexible Water Connectors: ASME A112.18.6.
2. Floor Drains: ASME A112.6.3.
3. Grab Bars: ASTM F 446.
4. Hose-Coupling Threads: ASME B1.20.7.
5. Off-Floor Fixture Supports: ASME A112.6.1M.
6. Pipe Threads: ASME B1.20.1.
7. Plastic Toilet Seats: ANSI Z124.5.
8. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures of unit shell.
b. Faulty operation of controls, blowers, pumps, heaters, and timers.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

A. Lavatory Faucets:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

a. Chicago Faucets.
b. Elkay Manufacturing Co.
c. Moen, Inc.

2. Description: See plumbing schedule.

2.2 SINK FAUCETS

A. Sink Faucets:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

a. Chicago Faucets.
b. Elkay Manufacturing Co.
c. Moen, Inc.

2. Description: See plumbing schedule.

2.3 FLUSHOMETERS

A. Flushometers:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

a. Sloan Valve Company.
b. Zurn

2. Description: See plumbing schedule.

2.4 TOILET SEATS

A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

a. American Standard Companies, Inc.
b. Bemis Manufacturing Company.
c. Kohler Co.

2. Description: See plumbing schedule.

2.5 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

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. TRUEBRO, Inc.

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.

2.6 FIXTURE SUPPORTS

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. MIFAB Manufacturing Inc.
2. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Watts Drainage.

B. Water-Closet Supports:

1. Description: See plumbing schedule.

C. Urinals Supports:

1. Description: See plumbing schedule.

D. Lavatory Supports:

1. Description: See plumbing schedule.

E. Sink Supports:

1. Description: See plumbing schedule.

2.7 WATER CLOSETS

A. Water Closets:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

a. Crane Plumbing, L.L.C./Fiat Products.
b. American Standard Companies, Inc.
c. Zurn
d. Kohler
e. Toto USA.

2. Description: See plumbing schedule.

B. Urinals:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

a. Crane Plumbing, L.L.C./Fiat Products.
b. American Standard Companies, Inc.
c. Zurn
d. Kohler
e. Toto USA.

2. Description: See plumbing schedule.

2.8 LAVATORIES

A. Lavatories:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

a. American Standard Companies, Inc.
b. Toto USA
c. Crane Plumbing, L.L.C./Fiat Products.

2. Description: See plumbing schedule.

2.9 KITCHEN SINKS

A. Kitchen Sinks:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

    a. Elkay USA
    b. Acorn
    c. Willoughby

2. Description: See plumbing schedule.

2.10 SERVICE BASINS

A. Mop Service Basim:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

    a. American Standard Companies, Inc.
    b. Toto USA
    c. Crane Plumbing, L.L.C./Fiat Products.

2. Description: See plumbing schedule.

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 plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

G. Install counter-mounting fixtures in and attached to casework.

H. Install fixtures level and plumb according to roughing-in drawings.

I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

L. Install flushometer valves for accessible water closets with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

N. Install toilet seats on water closets.

O. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

P. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

Q. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

R. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.

2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

S. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Escutcheons for Plumbing Piping."

T. Set service basins in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."

U. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust controls. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

D. Replace washers and seals of leaking and dripping faucets and stops.

E. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

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.

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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" for fixtures for people with disabilities.

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. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.

E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a refrigerant, unless otherwise indicated.

1.6 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. Filter Cartridges: Equal to 10 percent of amount installed for each type and size indicated, but no fewer than 3 of each.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

A. Drinking Fountains: See Drawings for schedules and description.
   1. Manufacturers:
      a. Elkay Manufacturing Co.
      b. Oasis.
      c. Halsey Taylor
      d. Acorn Engineering Co.

2.2 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Josam Co.
   2. MIFAB Manufacturing, Inc.
   3. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
   1. Type I: Hanger-type carrier with two vertical uprights.
   2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
   3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

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. Set pedestal drinking fountains on floor.

C. Install recessed drinking fountains secured to wood blocking in wall construction.

D. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation.

F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

G. 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."

H. 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 or gate shutoff valve on water supply to each fixture. Comply with valve requirements.

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.

B. Adjust water cooler temperature settings.

3.5 FIELD QUALITY CONTROL

A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.

1. Remove and replace malfunctioning units and retest as specified above.
2. Report test results in writing.

3.6 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 230010 – SUMMARY OF MECHANICAL WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 23 Specification Sections, apply to this Section.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, and is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.

B. Mechanical Contract Documents were prepared for the Project by:
Ethos Engineering,
119 West Van Buren, Suite 101
Harlingen, Texas 78550
Phone Number: (956) 230-3435

C. Scope of Work: Refer to drawings for a detailed Scope of Work.
1. Provide all materials and labor associated with new fully-operational mechanical and controls systems for the project "Idea Academy, Robindale Campus", including but not limited to the following:
   a. Space conditioning packaged units on roof curbs, with direct-expansion cooling, staged compressors and variable fan speed, electric duct heaters, controls, and accessories for a complete and operational system.
      1) For units served by pretreated air from the DOAS, OA hood, HGRH coils, economizers are not required.
      2) For units not served by DOAS, provide hot gas reheat, CO2 based demand controlled ventilation, and economizer controls to meet IECC requirements.
   b. Dedicated outside air pretreatment rooftop units on roof curbs, with direct-expansion cooling, variable speed compressors and variable fan speed, hot gas reheat, controls, and accessories for a complete and operational system. Provide full economizer control to meet IECC requirements.
   c. Space conditioning units with direct-expansion cooling split systems.
   d. VAV diffusers, temperature sensors and bypass damper controls.
   e. Building exhaust fans and associated louvers.
   f. Kitchen hood, kitchen ventilation system, associated grease duct and fire suppression system.
   g. Ductwork, diffusers, grilles, dynamic fire dampers, control dampers, zone dampers, OA intake louvers, and other accessories.
   h. Testing, Adjusting, & Balancing (TAB) shall not be provided under the mechanical contract. General contractor to provide TAB. Coordinate work.
   i. Building Automation System. Controls contractor is responsible for all controls relays, contactors, power to DDC panels, dampers, and other controls equipment. Integrate with RTU controllers. Although contractor may coordinate with other

trades to provide miscellaneous electrical and mechanical work, the final responsibility for achievement of control sequences lies with controls contractor.

1) Adjustable limited-range thermostats and integrate with BAS.
2) Connect to Central Operator's station via communications network.
3) For RTUs served by DOAS, provide space CO2 sensors, motorized OA dampers on OA duct connections, controls sequences to modulate OA dampers to maintain CO2 setpoint. In the main OA ducts from the DOAS, provide static pressure sensor to modulate DOAS fan speed. CO2 based DCV shall be overridden during economizer operation, and OA dampers shall go to 100% (adj) open position.

j. Shop drawing submittals for all mechanical systems including but not limited to equipment, ductwork and piping.

k. Coordination drawings for placing of mechanical systems in relation to work by other disciplines.

l. Contractor is responsible for providing wind storm certification inspections and certifications for exterior mounted equipment. Contractor must notify Inspector prior to installing equipment, and apprise inspector of work scheduling involving equipment requiring wind inspection / certification, so that inspections may be carried out at required stage(s) of construction. Cost for inspection shall be borne by the Contractor. Inspector shall be certified by the Texas Department of Insurance (see www.tdi.state.tx.us for a list of certified Inspectors).

m. Coordinate electrical work with Div. 26 as required.

n. Coordinate fire alarm related work with Fire Alarm Contractor. Provide smoke detectors, wiring and controls for units, 2000 cfm and larger, where none exist.

2. Painting: See Division 9 specifications. Paint all exposed piping, ductwork, insulation, hangers, accessories in interior exposed areas. Paint exterior pipe supports. Coordinate paint type, color and scope of work with Architect.

1.3 ALLOWANCES

A. Allowances are included in the Division 1 specifications.

1.4 COORDINATION

A. All mechanical work shall be done under sub-contract to a General Contractor. Mechanical Contractor shall coordinate all work through General Contractor, who is ultimately responsible for the entire project.

B. Prior to bidding, Mechanical Contractor shall coordinate all work in Division-23 for integration with TAB, plumbing, electrical, controls work and general construction. A detailed list of inclusion and exclusions shall be provided to General Contractors at least three days prior to the end of the period set aside to request clarifications so that coordination of any missing items may be addressed and clarified by Architect/Engineer as needed.

C. All electrical work required for operation of mechanical systems shall be coordinated through the General Contractor prior to bidding to ensure that all starters, disconnects, VFD’s, conduit and wiring are provided as part of the project. All components needed for a full operational installation of systems shall be provided.

D. All controls required for operation of mechanical systems shall be coordinated prior to bidding, to ensure that all equipment, materials, sensors, devices and labor are provided as part of the project. All components needed for a full operational installation of systems shall be provided. Mechanical Contractor shall coordinate and supervise installation of all controls systems.

E. All questions, requests for information, submittals, and correspondence from the Div. 23 Contractor shall be submitted via the General Contractor, who will forward to the Architect, who will then forward to the Engineer.

F. Div. 23 Contractor shall not make any changes to design without written authorization from the Engineer. If changes are requested by the Owner, Architect, General Contractor, Suppliers, Manufacturers, or any others, Contractor should issue a written RFI for response by the Engineer.

G. Div. 23 Contractor shall issue seven days written notice prior to any activities that require the presence of the Engineer at the job-site. This applies to all inspections required by specifications, and particularly to those where work will be covered.

H. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Ensure that systems are ready for controls and electrical connections when needed so as to not delay construction.

I. Contractor shall coordinate with other divisions for power and control of mechanical systems. It is not the intent of this specification to dictate who will conduct work, only to state the requirements of conducting the work.

J. Coordinate with Div. 1 for work sequence and optimization of construction schedule.

K. Coordinate with Div. 21 for Fire Suppression System.

L. Coordinate with Div. 22 for Plumbing System.

M. Coordinate with Div. 26 electrical contractor for providing power to mechanical equipment, and for Fire Alarm Systems interface with mechanical systems.

N. Coordinate TAB activities with TAB Contractor.

O. Coordinate commissioning activities with Commissioning Agent.

P. Issue written notification of the following tasks and allow five (5) days for Engineer to respond and schedule an inspection as required. Failure to issue written notification may result in work having to be redone to allow for proper inspection. It is contractor's responsibility to make sure Engineer receives notification.
   1. Upon completion of ductwork and prior to testing and insulating.
   2. Metal duct leakage testing.
   3. Above ceiling inspections prior to ceiling tile installation.
   4. When ready to request manufacturer's start-up of each piece of equipment.
   5. When ready for Systems Readiness Checklists (Commissioning).
   6. When ready for Functional Performance testing (Commissioning).
   7. When ready for an inspection by TAB contractor prior to developing detailed TAB Plan.
   8. When ready to conduct complete Automation System software demonstration.

9. When ready for Substantial Completion Inspection.
10. When ready for Final Inspection.

Q. General

1. The Contractor shall execute all work hereinafter specified or indicated on accompanying Drawings. Contractor shall provide all equipment necessary and usually furnished in connection with such work and systems whether or not mentioned specifically herein or on the Drawings.
2. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation and thereby to provide an integrated satisfactory operating installation.
3. The Mechanical, Electrical, Plumbing, and associated Drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every pipe or conduit in its exact location. These details are subject to the requirements of standards referenced elsewhere in these specifications, and structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be organized and laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
4. When the mechanical, electrical and plumbing drawings do not give exact details as to the elevation of pipe, conduit and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with proper grades for the functioning of the system involved. Piping, exposed conduit and the duct systems are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas.

1.5 WORK SEQUENCE

A. Locate Utilities:

1. Coordinate with power, water, sewer, telephone, communications, and other utilities as well as designated Owner's personnel to locate all utilities prior to digging in any area.
2. Obtain any approvals required from utilities to relocate utilities.
3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.
4. Where several new utilities must share a common area or path, coordinate with other trades so that the proper clearances are maintained and utilities may be installed in compliance with all requirements.
5. Refer to Civil Plans for coordination of connection points from site utilities to buildings.

B. Coordinate with Division 1 requirements to optimize construction schedule.

C. Provide equipment and material submittals, coordination drawings and shop drawings as required by specifications.

D. Submit detailed mechanical Schedule of Values with Submittals. Mechanical Submittals will not be accepted without a detailed Schedule of Values.

E. Sequence construction in coordination with work by other disciplines.

1.6 CONTRACTOR USE OF PREMISES

A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
   1. Driveways and Entrances: Keep driveways and entrances to construction site clear and available to other Contractors, Owner, and A/E personnel at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:
   1. Temporary fencing around construction areas.
   2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
   3. Temporary fencing around equipment while site work is in progress.

1.7 SUBMITTALS

A. Manufacturer's standard dimensioned drawings, performance and product data shall be edited to delete reference to equipment, features, or information which is not applicable to the equipment being supplied for this project.

B. Provide all mechanical submittals at the same time in one or multiple bound volumes. Include originals from manufacturer. All submittals shall be in native pdf and searchable format. Faxes and copies of faxes are not acceptable.

C. Provide sufficient copies of approved data, with the engineer's approved stamp, for inclusion in the operations and maintenance manuals.

D. Provide detailed coordination drawings showing how mechanical system components will be installed in coordination with work by others. Engineer’s drawing files will be made available to Contractor for producing coordination and as-built drawings upon request.

1.8 SCHEDULE OF VALUES -Special Requirements

A. Mechanical Contractor shall submit a Schedule of Values reflecting the total value of Mechanical Work in the Contract, and broken down into the following items as a minimum, with a line-item for Materials/Equipment and another for Labor:

MECHANICAL

1. HVAC equipment
2. HVAC materials (ductwork, piping, dampers)
3. HVAC labor
4. Controls equipment
5. Controls labor
6. Controls engineering and programming
7. Controls commissioning and closeout (minimum 10% of total controls cost)
8. Controls training (minimum 5% of total controls cost)
9. TAB
10. Commissioning related activities
11. Allowances.
12. Miscellaneous
13. Administrative and project management.

B. Schedule of Values shall be included with bound submittals. Submittals without a Schedule of Values shall not be reviewed.

1.9 EQUIPMENT MANUFACTURERS

A. Mechanical design is based on equipment and materials scheduled and specified. These are used as the basis for performance characteristics, quality, and physical dimensions/weight.

B. Equipment and materials by other APPROVED manufacturers may be provided by Contractor. In doing so, Contractor assumes responsibility for the performance, quality, and physical dimensions of the proposed units.

C. Any costs associated with modifications to the design due to submittal of equipment and/or materials other than those used as the basis of design are the Contractor's responsibility. This includes any design time, production of drawings, and time delays.

D. Where use of equipment and/or materials other than those used as the basis of design impact other disciplines, Contractor shall assume responsibility for all costs associated with any APPROVED modifications. This may include resizing of electrical circuits, modifying openings in the structure, relocating floor drains, etc.

1.10 OPERATIONS AND MAINTENANCE MANUALS & TRAINING

A. Submit Operations and Maintenance Manuals two weeks prior to Substantial Completion Inspection. Engineer will not conduct a Substantial Completion Inspection without having reviewed Operations and Maintenance Manuals.

B. Use Operations and Maintenance Manuals as a guide for conducting training of Owner's personnel.

SECTION 230010 – SUMMARY OF MECHANICAL WORK

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 230010

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC 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 general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque. Unless otherwise noted, windings shall be:

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 HP shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC 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. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers:

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:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, 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: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers:

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.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   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.
   2. 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: Cast-iron wall sleeves.
   2. Exterior Concrete Walls below Grade: Cast-iron wall sleeves with sleeve-seal system. 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: Cast-iron wall sleeves with sleeve-seal system. 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: Galvanized-steel-pipe sleeves.
   5. Interior Partitions: Galvanized-steel-pipe sleeves.

END OF SECTION 230517

SECTION 230518 - ESCUTCHEONS FOR HVAC 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-plated and rough-brass finish 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-plated and rough-brass finish and with concealed hinge and setscrew.

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 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. Insulated Piping: One-piece, stamped-steel type.
    c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
    d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
    e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
    f. Bare Piping in Equipment Rooms: One-piece, cast-brass type with rough-brass finish.

2. Escutcheons for Existing Piping:
    a. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
    b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
    c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
    d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
    e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
    f. Bare Piping in Unfinished Service Spaces: Split-casting brass type with rough-brass finish.
    g. Bare Piping in Equipment Rooms: Split-casting brass type with rough-brass finish.

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.
2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 230518

SECTION 230529 - 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. 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. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.
4. Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts" for duct hangers and 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 HVAC 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 ACTION 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.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "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.

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:
      a. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.
      c. Flex-Strut Inc.
      d. GS Metals 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.
   8. Paint Coating: Epoxy.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers:
   1. Carpenter & Paterson, Inc.
   2. ERICO/Michigan Hanger Co.
   3. PHS Industries, Inc.
   4. Pipe Shields, Inc.
   5. Rilco Manufacturing Company, Inc.
   6. Value Engineered Products, Inc.

B. Insulation-Insert Material for Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type, 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. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

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 or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. 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: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounted-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 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.8 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 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. 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 Section 077200 "Roof Accessories" for curbs.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic 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.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. 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.

L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. 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.

N. 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.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24: 24 inches long and 0.105 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 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 carbon-steel pipe hangers and supports metal trapeze pipe hangers and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. 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. 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.
3. 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.
4. 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.
5. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
6. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
7. 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.

K. 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.

L. 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. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. 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. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. 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.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230548.13 - VIBRATION CONTROLS 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. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Housed-restrained-spring isolators.
5. Elastomeric hangers.
6. Spring hangers.
7. Vibration isolation equipment bases.

B. Related Requirements:

1. Section 210548.13 "Vibration Controls for Fire Suppression" for devices for fire-suppression equipment and systems.
2. Section 220548.13 "Vibration Controls for Plumbing" for devices for plumbing equipment and systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For each vibration isolation device.

1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

D. Wind-Restraint Details:

1. Basic Wind Speed: Refer to Arch.
2. Building Classification Category: Refer to Arch.
3. Code recommended wind pressure multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.
4. Design Analysis: To support selection and arrangement of **wind** restraints. Include calculations of combined tensile and shear loads.
5.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For testing agency.

C. Welding certificates.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Provide operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.

8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

B. Elastomeric Isolation Pads:
1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
2. Size: Factory or field cut to match requirements of supported equipment.
3. Pad Material: Oil and water resistant with elastomeric properties.
4. Surface Pattern: Ribbed or Waffle pattern.
5. Infused nonwoven cotton or synthetic fibers.
6. Load-bearing metal plates adhered to pads.
7. Sandwich-Core Material: Resilient and elastomeric.

a. Surface Pattern: Ribbed or Waffle pattern.
b. Infused nonwoven cotton or synthetic fibers.

C. Double-Deflection, Elastomeric Isolation Mounts:
1. Mounting Plates:

a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded.
b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

D. Restrained Elastomeric Isolation Mounts
1. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

a. Housing: Cast-ductile iron or welded steel.
b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

E. Freestanding, Laterally Stable, Open-Spring Isolators:
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

F. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:
1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.

a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
b. Top plate with threaded mounting holes elastomeric pad.
c. Internal leveling bolt that acts as blocking during installation.

2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

G. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

H. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

I. Steel Rails: Factory-fabricated, welded, structural-steel rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Rails shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

J. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

2.2 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Isolation Technology, Inc.
4. Kinetics Noise Control.
5. Mason Industries.
6. Vibration Eliminator Co., Inc.
7. Vibration Isolation.
8. Vibration Mountings & Controls, Inc.

B. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

3.3 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03 Sections.

3.4 VIBRATION-CONTROL AND WIND-RESTRAINT DEVICE INSTALLATION

A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Install cables so they do not bend across edges of adjacent equipment or building structure.

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.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust active height of spring isolators.

END OF SECTION 230548.13

SECTION 230553 - 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. Pipe labels.
4. Duct labels.
5. Stencils.
6. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. 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. 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. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
5. Fasteners: Stainless-steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

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. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

D. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

E. Fasteners: Stainless-steel rivets or self-tapping screws.

F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

G. 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 according to ASME A13.1.

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; also include 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 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

D. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

E. Fasteners: Stainless-steel rivets or self-tapping screws.

F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

G. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include 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.

2.5 WARNING TAGS

A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety-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 GENERAL INSTALLATION REQUIREMENTS

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.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Division 09 Sections.

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, 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. Pipe Label Locations: 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 and on both sides of 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. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

E. Pipe Label Color Schedule: Coordinate with Owner.

3.5 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes: Coordinate with Owner.

B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 PAINTING

A. Clarification: In exposed areas (with no acoustic ceiling tiles), piping and piping insulation shall be painted. Although Division 9 may not specifically call for painting of MEP items, it states paint type and requirements for different materials. To extent possible coordinate painting with Division 9 and with Architect. Where adequate specifications are not available, use the following general guidelines:
   1. Ferrous Metal: Semi-Gloss, Alkyd-Enamel Finish: 2 finish coats over an enamel undercoat and primer.
      a. Primer: Quick-drying, rust-inhibitive, alkyd-based or epoxy-metal primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils. S-W: Kem Kromik Universal Metal Primer B50NZ6/B50WZ1.
      b. Undercoat: Alkyd, interior enamel undercoat or semi-gloss, interior, alkyd-enamel finish coat, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils. S-W: Pro-mar 200 Interior Alkyd Enamel B34W200 Series.
      c. Finish Coat: Same as undercoat. Semi-gloss, alkyd, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
   2. ASJ Jacket: Semi-Gloss, Acylic-Enamel Finish: 2 finish coats.
      a. Undercoat: Semi-gloss acrylic latex enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 mils. S-W: Pro-Mar Interior Latex Egg-Shell Enamel B20W200.

b. Finish Coat: Same as undercoat. Semi-gloss, acrylic latex enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils

B. Final colors shall be coordinated with Owner and Architect during construction.

END OF SECTION 230553

SECTION 230593 - 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. TAB work shall not be contracted under Division 23 Contractor. Third party TAB Contractor shall be contracted by the Prime Contractor. Coordinate activities and assist TAB Contractor as needed.

B. Section Includes:

1. Balancing Air Systems:
    a. Constant-volume air systems.
    b. Variable-air-volume systems.
2. Testing, Adjusting, and Balancing Equipment:
    a. Motors.
    b. Condensing units.
    c. Heat-transfer coils.
3. Testing, adjusting, and balancing existing systems and equipment.
4. Duct leakage tests.
5. Control system verification.
6. Other tests as specified.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

1.4 PREINSTALLATION MEETINGS

A. TAB Conference: If requested by the Owner, conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Needs for coordination and cooperation of trades and subcontractors.
d. Proposed procedures for documentation and communication flow.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 60 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. System Readiness Checklists: Within 7 days of Contractor's Notice, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. 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.

1.6 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.7 FIELD 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.

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 installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and 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 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 and pump 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 verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine operating safety interlocks and controls on HVAC equipment.

O. 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 the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable-frequency controllers' startup is complete and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

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" and in this Section.

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, valve position indicators, 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. Cross-check 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. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report artificial loading of filters at the time static pressures are measured.

3. 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.
4. Obtain approval from Architect 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.
5. 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 occurs. 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.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:

    a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
    b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
    c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
    d. Adjust controls so that terminal is calling for minimum airflow.
    e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
    f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
    g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.

b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

6. Measure fan static pressures as follows:

a. Measure static pressure directly at the fan outlet or through the flexible connection.
b. Measure static pressure directly at the fan inlet or through the flexible connection.
c. Measure static pressure across each component that makes up the air-handling system.
d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
b. Verify that terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
9. Verify final system conditions as follows:

a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
b. Re-measure and confirm that total airflow is within design.
c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
d. Mark final settings.
e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
f. Verify tracking between supply and return fans.

3.7 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. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.

8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.8 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record fan and motor operating data.

3.9 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.
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.

3.10 TEMPERATURE TESTING

A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

D. Data may be trended using Building Automation System. However, calibration of DDC sensors must be verified prior to trending data.

3.11 PROCEDURES FOR SPACE PRESSURIZATION MEASUREMENTS AND ADJUSTMENTS

A. Before testing for space pressurization, observe the space to verify the integrity of the space boundaries. Verify that windows and doors are closed and applicable safing, gaskets, and sealants are installed. Report deficiencies and postpone testing until after the reported deficiencies are corrected.

B. Measure, adjust, and record the pressurization of each room, each zone, and each building by adjusting the supply, return, and exhaust airflows to achieve the indicated conditions.

C. Measure space pressure differential where pressure is used as the design criteria, and measure airflow differential where differential airflow is used as the design criteria for space pressurization.
   1. For pressure measurements, measure and record the pressure difference between the intended spaces at the door with all doors in the space closed. Record the high-pressure side, low-pressure side, and pressure difference between each adjacent space.
   2. For applications with cascading levels of space pressurization, begin in the most critical space and work to the least critical space.
   3. Test room pressurization first, then zones, and finish with building pressurization.

D. To achieve indicated pressurization, set the supply airflow to the indicated conditions and adjust the exhaust and return airflow to achieve the indicated pressure or airflow difference.

E. For spaces with pressurization being monitored and controlled automatically, observe and adjust the controls to achieve the desired set point.
   1. Compare the values of the measurements taken to the measured values of the control system instruments and report findings.
   2. Check the repeatability of the controls by successive tests designed to temporarily alter the ability to achieve space pressurization. Test overpressurization and underpressurization, and observe and report on the system's ability to revert to the set point.
   3. For spaces served by variable-air-volume supply and exhaust systems, measure space pressurization at indicated airflow and minimum airflow conditions.

F. In spaces that employ multiple modes of operation, such as normal mode and emergency mode or occupied mode and unoccupied mode, measure, adjust, and record data for each operating mode.

G. Record indicated conditions and corresponding initial and final measurements. Report deficiencies.

3.12 PROCEDURES FOR INDOOR-AIR QUALITY MEASUREMENTS

A. After air balancing is complete and with HVAC systems operating at indicated conditions, perform indoor-air quality testing.

B. Observe and record the following conditions for each HVAC system:
   1. The distance between the outside-air intake and the closest exhaust fan discharge, flue termination, or vent termination.

2. Specified filters are installed. Check for leakage around filters.
3. Cooling coil drain pans have a positive slope to drain.
4. Cooling coil condensate drain trap maintains an air seal.
5. Evidence of water damage.
6. Insulation in contact with the supply, return, and outside air is dry and clean.

C. Measure and record indoor conditions served by each HVAC system. Make measurements at multiple locations served by the system if required to satisfy the following:
1. Most remote area.
2. One location per floor.
3. One location for every 5000 sq. ft..

D. Measure and record the following indoor conditions for each location two times at two-hour intervals, and in accordance with ASHRAE 113:
1. Temperature.
2. Relative humidity.
3. Air velocity.
4. Concentration of carbon dioxide (ppm).

3.13 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

3.14 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.
10. Verify controls sequences for other MEP items as specified.

3.15 TOLERANCES

A. Set HVAC system's airflow rates and water 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.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.16 PROGRESS 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 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.

3.17 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.
3. Certify validity and accuracy of field data.

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 specialist.
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. Damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. VFD settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic 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. Pipe and valve sizes and locations.
4. Terminal units.
5. Balancing stations.
6. Position of balancing devices.

E. RTU/Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

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 airflow 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. Heating-coil static-pressure differential in inches wg.
h. Outdoor airflow in cfm.
i. Return airflow in cfm.
j. Outdoor-air damper position.
k. Return-air damper position.
l. Vortex damper position.

F. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btu/h.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Airflow rate in cfm.
i. Face area in sq. ft..
j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h.
b. Airflow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

G. 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.

H. 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 airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

I. 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. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

J. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, include the following:

1. Unit Data:
a. Unit identification.
b. Location.
c. Unit make and model number.
d. Compressor make.
e. Compressor model and serial numbers.
f. Refrigerant weight in lb.
g. Low ambient temperature cutoff in deg F.

2. Test Data (Indicated and Actual Values):
a. Inlet-duct static pressure in inches wg.
b. Outlet-duct static pressure in inches wg.
c. Entering-air, dry-bulb temperature in deg F.
d. Leaving-air, dry-bulb temperature in deg F.
e. Control settings.
f. Unloader set points.
g. Low-pressure-cutout set point in psig.
h. High-pressure-cutout set point in psig.
i. Suction pressure in psig.
j. Suction temperature in deg F.
k. Condenser refrigerant pressure in psig.
l. Condenser refrigerant temperature in deg F.
m. Oil pressure in psig.
n. Oil temperature in deg F.
o. Voltage at each connection.
p. Amperage for each phase.
q. Kilowatt input.
r. Crankcase heater kilowatt.
s. Number of fans.
t. Condenser fan rpm.
u. Condenser fan airflow rate in cfm.
v. Condenser fan motor make, frame size, rpm, and horsepower.

w. Condenser fan motor voltage at each connection.
x. Condenser fan motor amperage for each phase.

K. Indoor-Air Quality Measurement Reports for Each HVAC System:
1. HVAC system designation.
2. Date and time of test.
3. Outdoor temperature, relative humidity, wind speed, and wind direction at start of test.
4. Room number or similar description for each location.
5. Measurements at each location.
6. Observed deficiencies.

L. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.18 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Architect.

B. Architect shall 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.

C. 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."

D. 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.

E. If TAB work fails, proceed as follows:

1. TAB specialists shall 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 specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
3. If the second verification also fails, design professional may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.19 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.

END OF SECTION 230593

SECTION 230713 - 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 located in unconditioned space.

B. Related Sections:
1. Section 230719 "HVAC Piping Insulation."
2. Section 233113 "Metal Ducts" for duct liners.

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 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.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. 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.

1.6 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 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.

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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, and are limited to, the following:
   1. Mineral-Fiber Insulation:
      a. CertainTeed
      b. Manson.
      c. Knauf FiberGlass GmbH.
      d. Owens-Corning Fiberglas Corp.
      e. Schuller International, Inc.

2.2 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. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. 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."

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. 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).
2. 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."

2.4 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).

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. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.6 SEALANTS

A. FSK and Metal 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: Aluminum.
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).
6. Sealants 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."

2.7 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. Width: 4 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.

2.10 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.

2. 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. 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.

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 Section 078413 "Penetration 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 Section 078413 "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 100 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.

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.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. 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.

D. 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.

3.7 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 9.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

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.

3.8 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.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 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 located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
7. Outdoor, concealed supply and return.
8. Outdoor, exposed supply and return.

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.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Service: Round & rectangular, supply-air ducts concealed.
1. Material: Mineral-fiber blanket.
2. Thickness: 3 inches (R-8 min).
3. Number of Layers: One.
4. Field-Applied Jacket: Foil and paper.
5. Vapor Retarder Required: Yes.

B. Service: Round & rectangular, return, outside-air and fume hood exhaust ducts concealed.
1. Material: Mineral-fiber blanket.
2. Thickness: 2 inches (R-6 min).
3. Number of Layers: One.
4. Field-Applied Jacket: Foil and paper.
5. Vapor Retarder Required: Yes.

C. Service: Round supply, make-up, and outside-air ducts, exposed in conditioned space.

1. Double wall, with 2” insulation thickness, and painted.

D. Service: Return air duct, exposed in conditioned space: No insulation. Paint duct.

E. Service: Ten feet of supply and return air ducts closest to AHU or FCU.
   1. Material: In addition to exterior wrap, provide internal liner for sound attenuation purposes.
   2. Thickness: 1 inches.

F. Service: Ten feet of exhaust air duct closest to where duct penetrates the exterior envelope.
   1. Material: Exterior wrap.
   2. Thickness: 2 inches.

G. Where ductwork is not completely concealed, paint all ductwork and insulation. Coordinate color and finish with Architect.

END OF SECTION 230713

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, indoors.
   2. Refrigerant piping, indoors and outdoors.

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 QUALITY ASSURANCE

A. 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.

1.5 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 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.

1.7 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 MANUFACTURERS

A. 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. Flexible Elastomeric Thermal Insulation:
      a. Aeroflex USA Inc.; Aerocel.
      b. Armacell LLC; AP Armaflex.
      c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

2.2 INSULATION MATERIALS

A. Mineral-fiber insulation will NOT be allowed for use on any cold piping systems.

B. Mineral-fiber wrap is NOT approved for use on piping insulation.

C. 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.

D. Products shall not contain asbestos, lead, mercury, or mercury compounds.

E. 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.

F. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

G. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

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 and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
   1. Products:
      a. Aeroflex USA Inc.; Aeroseal.
      b. Armacell LCC; 520 Adhesive.
      c. Foster Products Corporation, H. B. Fuller Company; 85-75.
      d. RBX Corporation; Rubatex Contact 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."

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:
      a. Childers Products, Division of ITW; CP-82.
      b. Foster Products Corporation, H. B. Fuller Company; 85-20.
      c. ITW TACC, Division of Illinois Tool Works; S-90/80.
      d. Marathon Industries, Inc.; 225.
      e. Mon-Eco Industries, Inc.; 22-25.

   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."

2.4 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).

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. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
   3. Service Temperature Range: 0 to plus 180 deg F.
   4. Color: White.

2.6 SEALANTS

A. Joint Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Permanently flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 100 to plus 300 deg F.
   4. Color: White or gray.
   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).
   6. Sealants 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. FSK and Metal 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: Aluminum.
   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).
   6. Sealants 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. ASJ Flashing Sealants, 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).

6. Sealants 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."

2.7 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. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
   2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 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.

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

2.10 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.

C. Metal Jacket:
   1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
      a. Factory cut and rolled to size.
      b. Finish and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier: 3-mil-thick, heat-bonded polyethylene and kraft paper.
      d. 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.

D. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Width: 3 inches.
   2. Thickness: 11.5 mils.
   3. Adhesion: 90 ounces force/inch in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. 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.

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.

2.12 SECUREMENTS

A. Bands:
   1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

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. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
   1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range. **NO EXCEPTION: PIPES SHALL BE PAINTED.**

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. 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 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 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 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.

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.

3.9 FINISHES

A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 9 Sections.
   1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
      a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.10 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 fittings, two locations of strainers, three locations of 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.

3.11 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.

3.12 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. Vapor Retarder Required: Yes.
c. Finish: Painted (Coordinate with Architect).

B. Refrigerant Suction and Hot-Gas Piping:
1. All Pipe Sizes: Insulation shall be:
a. Flexible Elastomeric: **1 inch** thick minimum, with two coats of protective coating recommended by the insulation manufacturer.
b. Vapor Retarder Required: Yes.
c. Finish: Painted (Coordinate with Architect).

3.13 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.

3.14 OUTDOOR PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:
1. All Pipe Sizes: Insulation shall be:
a. Flexible Elastomeric: **1 inch** thick minimum, with two coats of protective coating recommended by the insulation manufacturer.
b. Vapor Retarder Required: Yes.
c. Field-Applied Jacket: Aluminum jacket.

3.15 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.

1. Aluminum, Smooth with Z-Shaped Locking Seam: 0.020 inch thick.

3.16 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 230719

SECTION 230800 - COMMISSIONING OF HVAC

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 commissioning process requirements for the following MEP systems, assemblies, and equipment:
   1. HVAC equipment.
   2. Controls and instrumentation, including BAS energy monitoring and control system.

B. Related Requirements:
   1. Section 019113 "General Commissioning Requirements" for general commissioning process requirements and Commissioning Coordinator responsibilities.

1.3 DEFINITIONS

A. Refer to Section 019113 "General Commissioning Requirements" for additional definitions and assignment of responsibilities.

1.4 CONTRACTOR'S RESPONSIBILITIES

A. Refer to Section 019113 "General Commissioning Requirements".

B. Perform commissioning tests at the direction of the CxA.

C. Attend construction phase controls coordination meeting.

D. Attend testing, adjusting, and balancing review and coordination meeting.

E. Participate in mechanical systems, assemblies, equipment, and component maintenance orientation and inspection.

F. Provide information requested by the CxA for final commissioning documentation.

G. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for required test period.

H. Provide Project-specific construction checklists and commissioning process test procedures for actual mechanical systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

I. Direct and coordinate commissioning testing among subcontractors, suppliers, and vendors.

J. Verify testing, adjusting, and balancing of Work are complete.

K. Provide test data, inspection reports, and certificates in Systems Manual.

1.5 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:
   1. Plan for delivery and review of systems manuals, and other documents and reports.
   2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
   3. Process and schedule for completing construction checklists and manufacturer's pre-start and startup checklists for mechanical systems, assemblies, equipment, and components to be verified and tested.
   4. Certificate of completion certifying that installation, pre-start checks, and startup procedures have been completed.
   5. Certificate of readiness certifying that mechanical systems, subsystems, equipment, and associated controls are ready for testing.
   6. Test and inspection reports and certificates.
   7. Corrective action documents.
   8. Verification of testing, adjusting, and balancing reports.

1.6 INFORMATIONAL SUBMITTALS

A. Construction Checklists: See related Sections for technical requirements, and generate construction checklists for the following:
   1. Instrumentation and control for MEP systems.
   2. Fans, Air-handling units and fan coil units.

B. Certificates of readiness.

C. Certificates of completion of installation, pre-start, and startup activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Refer to Section 019113 "General Commissioning Requirements".

3.2 SYSTEMS READINESS CHECKLISTS

A. Construction Checklists: Assist CxA in the preparation of detailed Systems Readiness checklists for systems, subsystems, equipment, and components.
   1. Contributors to the development of checklists shall include, but are not limited to:
      a. Systems and equipment installers.

b. TAB technicians.
c. Instrumentation and controls installers.

B. Contractor shall conduct Systems Readiness Testing to document compliance with installation and Systems Readiness checklists prepared by Commissioning Authority for Division-23 items.

C. Refer to Section 019113 "General Commissioning Requirements" for issues relating to Systems Readiness checklists and testing, description of process, details on non-conformance issues relating to pre-functional checklists and test.

3.3 SYSTEM START-UP

A. Contractor is solely responsible for system start-up. CxA may, at his discretion, witness start up procedures, but will not perform any Functional Testing of systems until Contractor has completed start-up and resolved all operating deficiencies.

3.4 TESTING PREPARATION

A. Certify that systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.

C. Certify that TAB procedures have been completed and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

3.5 TESTING AND BALANCING VERIFICATION

A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Provide technicians, instrumentation, and tools to verify testing and balancing of mechanical systems at the direction of the CxA.
1. The CxA will notify Contractor 4 days in advance of the date of field verification. Notice will not include data points to be verified.
2. The testing and balancing Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item includes a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report.
4. Remedy deficiency and notify CxA so verification of failed portions can be performed.

3.6 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of mechanical testing shall include entire HVAC installation, from equipment through distribution systems to each space served. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. Tests will be performed using design conditions whenever possible.

E. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the Contracting Officer and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

F. The CxA may direct that set points be altered when simulating conditions is not practical.

G. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

H. If tests cannot be completed because of a deficiency outside the scope of the mechanical system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

I. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.7 GENERAL TESTING PROCEDURES FOR HVAC SYSTEMS, SUBSYSTEMS, AND EQUIPMENT

A. HVAC Instrumentation and Control System Testing: Contractor shall fully test operation of controls system prior to requesting Functional Testing with CxA. Point-to-point check out sheets and as-built control diagrams shall be provided to CxA so he may develop testing procedures.

B. HVAC Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air distribution systems; special exhaust; and other distribution systems, including HVAC terminal equipment and unitary equipment.

3.8 FUNCTIONAL TEST PROCEDURES FOR SYSTEMS TO BE COMMISSIONED

A. General

1. The following paragraphs outline the functional test procedures for the various Div. 23 items to be commissioned. Functional testing will take place only after System Readiness

checklists have been completed, equipment has been started-up, TAB has been verified, and Contractor has certified that systems are ready for functional testing.
2. All systems controlled via the Building Automation System shall have all control points and sequences tested by Controls Contractor prior to requesting testing by CX Authority.
3. Functional testing of HVAC systems shall include testing of the BAS.

B. All Equipment:
1. Verify nameplate information (serial numbers, model numbers, etc.); verify that equipment capacity is in accordance with requirements of construction documents.
2. Verify unit runs smoothly and quietly.
3. Verify operation of safeties.
4. Verify electrical wiring and grounding is correct.
5. Verify maintenance and NEC clearances are maintained.
6. Verify Systems Readiness Checklists have been completed.

3.9 COMMISSIONING TESTS

A. Functional testing will be performed on all HVAC equipment, including but limited to the following:
1. RTUs
2. DOAS
3. FCUs
4. Split VRF systems
5. Exhaust fans
6. Air distribution system
7. Building automation system

B. Sample requirements are as follows:
1. Record temperatures, pressures.
2. Record programmed setpoints (unocc/occ temperature, RH, CO2, runtime, safeties, alarms).
3. Record programmed schedules and interlocks.
4. Verify equipment installation
5. Verify equipment operation.
6. Verify electrical voltage and amperages are within tolerance.
7. Verify unit data in TAB report.
8. Verify alarms and safeties.
9. Verify all sequences.
10. Verify setpoint resets, adaptive controls for energy conservation.

C. Customized system readiness checklists and function testing requirements will be released after the submittal review phase.

3.10 TRAINING AND O&M MANUALS

A. Refer to Div. 23 specifications.

END OF SECTION 230800

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. Section Includes:

1. DDC system for monitoring and controlling of HVAC systems.
2. Delivery of selected control devices to equipment and systems manufacturers for factory installation and to HVAC systems installers for field installation.

B. Related Requirements:

1. Section 230993 "Sequence of Operations for HVAC Controls" for control sequences in DDC systems.

1.3 CODE REQUIREMENTS

A. All equipment and material and its installation shall conform to the current requirements of the following authorities, and local amendments:
1. Occupational Safety and Health Act (OSHA)
2. International Electric Code (IEC)
3. International Fire Code
4. International Building Code
5. International Mechanical Code
6. International Plumbing Code
7. International Energy Conservation Code
8. UL 916

B. Where two or more codes conflict, the most restrictive shall apply. Nothing in these specifications shall be construed to permit work not conforming to applicable codes.

1.4 ACTION SUBMITTALS

A. All submittals must be in native PDF format, wherein all text is searchable. Submittals which contain scanned documents which are not 'searchable' will be rejected without being reviewed.

B. Product Data: For each type of product include the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control

signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.

3. Product description with complete technical data, performance curves, and product specification sheets.
4. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.
5. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
6. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

C. System Description:

1. Full description of DDC system architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
2. General Requirements:

    a. Include cover drawing with Project name, location, Owner, Architect, Contractor and issue date with each Shop Drawings submission.
    b. Include a drawing index sheet listing each drawing number and title that matches information in each title block.

3. Schematic drawings for each controlled HVAC system indicating the following:

    a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
    b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
    c. A graphic showing location of control I/O in proper relationship to HVAC system.
    d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
    e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
    f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
    g. Narrative sequence of operation.

        1) Contractor is expected to review all specified sequences and submit questions concerning any ambiguities, potential errors or omissions, prior to turning in submittals. Submittals which simply restate control sequences as written in specifications are not acceptable. Submittals must include a restatement of sequences as they will actually be programmed.

4. DDC system network riser diagram; indicate each device connected to network with unique identification for each, communication protocol, speed and physical means of interconnecting network devices, such as copper cable type, or fiber-optic cable, network port(s) for connection of an operator workstation or other type of operator interface, etc.

5. Color graphics.

a. Submit samples and an itemized list of ALL the various graphics pages being proposed for control system. Show layout of pictures, graphics and data displayed, navigation icons, etc.
b. Graphics for equipment must be schematically correct versus equipment as actually installed (e.g., all sensors, coils, devices, shown in correct locations & sequential order).
c. Engineer's approval of submitted sample graphics pages represents preliminary approval and does not preclude the possibility that graphics' deficiencies may be found in subsequent testing and inspections.

D. Software Submittal:

1. Cross-referenced listing of software to be loaded on each operator workstation, server, gateway, and DDC controller.
2. Description and technical data of all software provided, and cross-referenced to products in which software will be installed.
3. Operating system software, operator interface and programming software, color graphic software, DDC controller software, maintenance management software, and third-party software.
4. Include a flow diagram and an outline of each subroutine that indicates each program variable name and units of measure.
5. Listing and description of each engineering equation used with reference source.
6. Listing and description of each constant used in engineering equations and a reference source to prove origin of each constant.
7. Description of operator interface to alphanumeric and graphic programming.
8. Description of each network communication protocol.
9. Description of system database, including all data included in database, database capacity and limitations to expand database.
10. Description of each application program and device drivers to be generated, including specific information on data acquisition and control strategies showing their relationship to system timing, speed, processing burden and system throughout.
11. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

1.5 INFORMATIONAL SUBMITTALS

A. All submittals must be in native PDF format, wherein all text is searchable. Submittals which contain scanned documents which are not 'searchable' will be rejected without being reviewed.

B. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved.

C. Systems Provider Qualification Data: Resume of project manager, installation and programming technician, and service technicians assigned to Project, including name, phone number, and e-mail address.

D. Product Certificates: Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with ASHRAE 135.

1.6 CLOSEOUT SUBMITTALS

A. As-built record documentation per section 017700 – Closeout Procedures.

B. Operation and Maintenance Data: For DDC system to include in emergency, operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
b. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
c. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
d. Engineering, installation, and maintenance manuals.
e. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
f. Backup copy of graphic files, programs, and database in electronic media form.
g. List of recommended spare parts with part numbers and suppliers.
h. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
i. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
j. Licenses, guarantees, and warranty documents.
k. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
l. Owner training materials.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Include product manufacturers' recommended parts lists for proper product operation over five-year period following warranty period. Parts list shall be indicated for each year.

1.8 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate supply of conditioned electrical circuits for control units.

C. Coordinate equipment with Division 16 Section "Panelboards".

1.9 PAYMENTS

A. 10% of controls cost will be withheld until documentation is provided that the Commissioning and Acceptance Test was carried out, and that it was verified by Engineer.

B. 5% of controls cost will be withheld until documentation is provided that the Training was carried out, and that it was acceptable by the Owner.

1.10 CONTRACTOR RESPONSIBILITY

A. All control items, services, and work shown in specifications and drawings shall be provided by Controls Contractor either directly or by subcontract. These shall include, but are not necessarily limited to, the following:

1. Install control equipment incorporating DDC for energy management, equipment monitoring and control, software, programming, including color graphic workstations.
2. Provide control relays and devices, air flow monitoring devices, pressure and temperature sensing devices, dampers and actuators, etc.
3. Provide electrical work associated with control system and as called for on Drawings. Perform all wiring in accordance with all local and national codes. Provide all line voltage wiring, concealed or exposed, in accordance with Div. 26. All low voltage electrical control wiring throughout the building when exposed shall be run in conduit in accordance with Division 26. All low voltage wiring run in concealed accessible areas shall be run using plenum rated wire only.
4. Provide 120V power for direct digital control systems PCU's, and LCU's, as defined later in these specifications, and make final panel hook-up and all final electrical connections to each controller. Provide power for all damper-actuators including VAV boxes.
   a. Power circuit to PCU/LCU shall serve PCU/LCU and no other equipment.
   b. Use spares or provide new circuit breaker.
5. Use spare circuit breakers or provide new where no spares exist.
6. Provide all wiring and conduit for all DDC temperature controls, monitoring devices including DDC signal wiring.
7. Provide all control relays. Where motor starters are not called for or do not exist for 1-phase equipment, provide relays and contactors as required for start/stop control by BAS.
8. Provide surge transient protection shall be incorporated in design of system to protect electrical components in all primary control units.
9. Provide all warranty related work, products, materials, and labor.
10. Provide all software programming.
11. Provide consulting and programming services to Owner and Installing Contractor as required to resolve operating problems after system installation.
12. Provide shop drawings indicating equipment locations, points allocation, and schematic wiring. Submittals shall indicate all information pertinent to PCU locations, PCU capacity and spare points, input/output module configuration within PCUs, communication trunks, sensors, valves, pneumatic interface, wiring, and other pertinent equipment information requiring approval prior to field installation. Provide a DDC system riser diagram showing buildings, controller or device within each building, and listing equipment controlled or monitored by each.
13. Provide graphics programming, showing floor plans of all buildings, equipment locations, and operating parameters.
14. Provide commissioning of system.
15. Provide reference manuals.
16. Provide Owner training.
17. Warranty work.
18. Other services, materials, and products as called for in construction documents.

B. The following equipment and services shall be coordinated with the Owner:
   1. Network connections.

C. Coordinate with Mechanical Contractor. Mechanical Contractor provides:
   1. Installation of control dampers, actuators and all manual dampers.
   2. Temporary 24V thermostat for new equipment, if required.
   3. Fan coil units with factory-installed dampers (where indicated).
   4. Rooftop / AH units with factory-installed outside air damper actuator and controls.

1.11 QUALITY ASSURANCE

A. DDC System Manufacturer Qualifications:

   1. Nationally recognized manufacturer of DDC systems and products.
   2. DDC systems with similar requirements to those indicated for a continuous period of ten years within time of bid.
   3. Having complete published catalog literature, installation, operation and maintenance manuals for all products intended for use.
   4. Having full-time in-house employees for the following:

      a. Product research and development.
      b. Product and application engineering.
      c. Product manufacturing, testing and quality control.
      d. Technical support for DDC system installation training, commissioning and troubleshooting of installations.
      e. Owner operator training.

B. DDC System Provider / Installer Qualifications:

   1. A direct factory owned office of the manufacturer, for the brand or make of control equipment to be supplied, with engineers capable of providing instructions, routine maintenance, design services, programming, and emergency system service on staff.
   2. Project supervisor and programmers shall be DDC system manufacturer employees. Only construction services not directly related to DDC system operation (such as provision of electrical power, conduit installation and wire-pulling, etc.) may be subcontracted to non-manufacturer workers.
   3. A manufacturer’s employee working on this project shall be officed within 40 miles of Project and assigned to support Project during warranty period.
   4. Each manufacturer employee assigned to Project shall be a competent and experienced full-time employee with demonstrated past experience on at least 5 projects of similar complexity, scope and value.

1.12 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period.

   1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.
   2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.

      a. Install updates only after receiving Owner's written authorization.

3. Warranty service shall occur during normal business hours and commence no later than 8 hours following Owner's warranty service request.
4. Warranty Period: **Two years from date of final system acceptance**.

   a. Final Acceptance of system is not related to nor dependent upon Substantial Completion. Final system acceptance will be granted only after system is operating without any substantive problems for a minimum of 30 consecutive days, and all issues on Commissioning Issues Log and Engineer's punch lists have been resolved. Obtain formal written approval from Engineer and Owner contractual date of system Final Acceptance.

B. Warranty Inspections

1. At approximately 12 months and 24 months after Final Acceptance of control system, provide a minimum 5 hour on-site inspection of system.
2. Inspection will include an evaluation of performance of the system, including an accuracy of all sensors (re-calibration or replacement is required for sensors obviously inaccurate), solicitation of operator's input of system problems and inadequacies, review of operating sequences and alarm logs to discover potential recurring problems or nuisances, discovery of any failed points, and general system reliability.
3. Provide a written report of each site visit summarizing activities and findings, and recommendations for improving system performance.
4. Failure to provide the on-site inspections at a time near that specified, or by the end of Warranty, does not relieve contractor of obligation to provide such inspections.

1.13 EXTRA MATERIALS

A. Furnish quantity indicated of matching product(s) in Project inventory **for each unique size and type** of following:

1. Room Relative Humidity Sensor and Transmitter: Five.
2. Adjustable Range Room Temperature Sensors: Five.
3. CO2 sensor: Five.
4. Current-Sensing Relay: Five.

1.14 EQUIPMENT AND SOFTWARE UPDATES / UPGRADES / REVISIONS

A. Equipment: All equipment, components, parts, materials, etc. provided shall be fully compatible with all other equipment provided at any other time throughout the warranty period. Should updated versions be provided that are not fully compatible with earlier equipment provided (e.g.: a requirement to add hardware or software "interfacing" between an earlier and later generation results in the system not being fully compatible), Controls contractor shall replace earlier equipment with the later version at no cost to Owner.

B. Software: If acceptable to the Owner, all software upgrades applicable to the system and offered by the manufacturer / contractor for this system shall be provided at no cost to the Owner throughout the warranty period. This no cost upgrade shall include installation, programming, modification to field equipment, data base revisions, etc. all as appropriate.

C. Revisions: Hardware / software revisions made related to refining sequences of control, adding/monitoring control points, or other similar operations shall be made with all "burn-in" performed at the contractor's expense, throughout the warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Following Manufacturer's are allowed to bid on this project:
   1. Johnson Controls
   2. Automated Logic Controls.

2.2 DDC SYSTEM DESCRIPTION

A. Modular, microprocessor-based, high-speed, peer-to-peer network of distributed DDC controllers, operator interfaces, and software monitoring and control, including analog/digital conversion and program logic, utilizing stand-alone controllers operating over a local area network allowing peer-to-peer communication among all system controllers, and communications interface to Owner's Central Operator's Station.

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.

2.3 WEB ACCESS

A. DDC system shall be Web based.

   1. DDC system software shall be based on server thin-client architecture, designed around open standards of Web technology. DDC system server shall be accessed using a Web browser over DDC system network, using Owner's LAN, and remotely over Internet.
   2. Intent of thin-client architecture is to provide operators complete access to DDC system via a Web browser. No special software other than a Web browser shall be required to access graphics, point displays, and trends; to configure trends, points, and controllers; and to edit programming.
   3. Web access shall be password protected.

2.4 PERFORMANCE REQUIREMENTS

A. Network Bandwidth: Design each network of DDC system to include at least 30 percent available spare bandwidth with DDC system operating under normal and heavy load conditions indicated. Calculate bandwidth usage, and apply a safety factor to ensure that requirement is satisfied when subjected to testing under worst case conditions.

B. System Response Time:

   1. Graphic display refresh shall update within eight seconds.
   2. AI point value shall update within 5 seconds, BI point values within 10 seconds.
   3. AO and BO points shall begin to respond to controller output commands within three second(s).
   4. Alarms of analog and digital points connected to DDC system shall be displayed within 15 seconds of activation or change of state.
   5. Global commands shall also comply with this requirement.

C. Future Expandability:

1. DDC system size shall be expandable to an ultimate capacity of at least four times total I/O points indicated.
2. Additional DDC controllers, I/O and associated wiring shall be all that is needed to achieve ultimate capacity. Initial network infrastructure shall be designed and installed to support ultimate capacity.
3. Operator interfaces installed initially shall not require hardware and software additions and revisions for ultimate capacity.

D. Environmental Conditions for Controllers, Gateways, and Routers:

1. Products, instruments and actuators shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.

    a. If product alone cannot comply with requirement, install product in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, cooled and ventilated as required by product and application.

2. Products shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Products not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:

    a. Outdoors, Protected: Type 3.
    b. Outdoors, Unprotected: Type 4X.
    c. Indoors, Heated with Ventilation: Type 2.
    d. Indoors, Heated and Air Conditioned: Type 1.
    e. Unconditioned Chiller and Boiler Rooms: Type 4X.
    f. Conditioned Mechanical Equipment Rooms: Type 1.
    g. Air-Moving Equipment Rooms: Type 1.
    h. Localized Areas Exposed to Washdown: Type 4X.

E. Electric Power Quality:

1. Protect DDC system products connected to ac power circuits from power-line surges to comply with requirements of IEEE C62.41. Do not use fuses for surge protection.
2. Ground Fault: Protect products from ground fault by providing suitable grounding. Products shall not fail due to ground fault condition.

F. UPS: Provide UPS power protection for Servers, and DDC controllers (except application-specific controllers), and Gateways.

G. Continuity of Operation after Electric Power Interruption: Equipment and associated factory-installed controls, field-installed controls, electrical equipment, and power supply connected to building normal and backup power systems shall automatically return equipment and associated controls to operating state occurring immediately before loss of normal power, without need for manual intervention by operator when power is restored either through backup power source or through normal power if restored before backup power is brought online.

2.5 PANEL-MOUNTED, MANUAL OVERRIDE SWITCHES

A. Manual Override of Control Dampers:

1. Include panel-mounted, two-position, selector switch for each automatic control damper being controlled by DDC controller. Label each switch with damper designation served by switch, and switch positions to indicate either "Manual" or "Auto" control signal to damper. With switch in "Auto" position signal to control damper actuator shall be control loop output signal from DDC controller.

    a. For Binary Control Dampers: Manual two-position switch shall have "Close" and "Open" switch positions indicated. With switch in "Close" position, damper shall close. With switch in "Open" position, damper shall open.
    b. For Analog Control Dampers: A gradual switch shall have "Close" and "Open" switch limits indicated. Operator shall be able to rotate switch knob to adjust damper to any position from close to open.

2. DDC controller shall monitor and report position of each manual override selector switch. With switch placed in "manual" position, DDC controller shall signal an override condition to alert operator that damper is under manual, not automatic, control.

2.6 SYSTEM ARCHITECTURE

A. System architecture shall consist of no more than two levels of LANs.

1. Level one LAN shall connect network controllers and operator workstations.
2. Level two LAN shall connect application-specific controllers to application-specific controllers.

B. Minimum Data Transfer and Communication Speed:

1. LAN Connecting Operator Workstations and Network Controllers: 100 Mbps.
2. LAN Connecting Programmable Application Controllers: 1000 kbps.
3. LAN Connecting Application-Specific Controllers: 19,200 bps.

C. DDC system shall consist of dedicated LANs that are not shared with other building systems and tenant data and communication networks.

D. System architecture shall be modular and have inherent ability to expand to not less than three times system size indicated with no impact to performance indicated.

E. Number of LANs and associated communication shall be transparent to operator. All I/O points residing on any LAN shall be capable of global sharing between all system LANs.

F. System design shall eliminate dependence on any single device for system alarm reporting and control execution. Each controller shall operate independently by performing its' own control, alarm management and historical data collection.

G. Special Network Architecture Requirements:

1. Air-Handling Systems: For control applications of an air-handling system that consists of air-handling unit(s) and VAV terminal units, include a dedicated LAN of application-specific controllers serving VAV terminal units connected directly to controller that is controlling air-handling system air-handling unit(s).

2.7 DDC SYSTEM OPERATOR INTERFACES

A. Operator Means of System Access: Operator shall be able to access entire DDC system through any of multiple means, including, but not limited to, the following:

1. Desktop and portable operator workstation with hardwired connection through LAN port.
2. Portable operator terminal with hardwired connection through LAN port.
3. Portable operator workstation with wireless connection through LAN router.
4. PDA with wireless connection through LAN router.
5. Remote connection using outside-of-system computer or PDA through Web access.

B. Access to system, regardless of operator means used, shall be transparent to operator.

C. Network Ports: For hardwired connection of desktop or portable operator workstation. Network port shall be easily accessible, properly protected, and clearly labeled.

D. Desktop and Portable Workstations:

1. Connect to DDC system Level one LAN through a communications port directly on LAN or through a communications port on a DDC controller.
2. Able to communicate with any device located on any DDC system LAN.
3. Able to communicate remotely with any device connected to any DDC system LAN.
4. Connect to DDC system sub-LANs through a communications port on an application-specific controller, or a room temperature sensor connected to an application-specific controller.
5. Monitor, program, schedule, adjust set points, and report capabilities of I/O connected anywhere in system.

E. Personal Digital Assistant:

1. Connect to system through a wireless router connected to LAN.
2. Able to communicate with any DDC controller connected to DDC system.

F. Critical Alarm Reporting:

1. Operator-selected critical alarms shall be sent by DDC system to notify operator of critical alarms that require immediate attention. System shall send alarm notification to multiple recipients that are assigned for each alarm.
2. Alarms must be set to observe proper time delays and other logic to avoid nuisance tripping.
3. **Coordinate with Owner's representatives to set up Owner's desired alarm notification procedures and methodologies by means including e-mail, text message and pre-recorded phone message to mobile and landline phone numbers.**

G. Simultaneous Operator Use: Capable of accommodating simultaneous operators that are accessing DDC system through any one of operator interfaces indicated.

2.8 NETWORK COMMUNICATION PROTCOL

A. Network communication protocol(s) used throughout entire DDC system shall be open to public and available to other companies for use in making future modifications to DDC system.

B. ASHRAE 135 Protocol:

1. ASHRAE 135 communication protocol shall be a required protocol used throughout entire DDC system. The Web Server shall support the BACnet Interoperable Building Blocks (BIBBS) for Read (Initiate) and Write (Execute) Services.
2. System shall not require use of gateways except to integrate HVAC equipment and other systems and equipment not required to use ASHRAE 135 communication protocol.

    a. Review manufacturer's communications protocols for all systems with which BAS will integrate, and provide gateways as required to allow full communication, such as, for examples, Modbus Application Protocol Specification V1.1b, LonWorks technology using CEA-709.1-C.

2.9 DESKTOP OPERATOR WORKSTATIONS

A. Not Applicable. Use Owner's existing.

2.10 PORTABLE OPERATOR WORKSTATIONS

A. Not Applicable. Use Owner's existing.

2.11 PRINTERS

A. Not Applicable. Use Owner's existing.

2.12 SERVERS

A. Furnish a Web Server to allow daily operations functions, using real-time system data, to be accomplished from any network connected web browser, from within the facility or in remote locations throughout the world.

B. Servers shall include software license(s), and CAT-5e or CAT-6 cable installation between server(s) and network.

C. Operators shall be able to utilize any commercially available browser such as Microsoft Internet Explorer or Netscape Navigator. No additional software shall have to be installed on the client PC for normal operation of the system.

D. All communications between the web browser and web server shall be encrypted using 128 bit SSL encryption.

E. Web server shall be able to be located on the Owner's Intranet or on the Internet.

F. Web server shall have the ability to automatically obtain an IP (Internet Protocol) address using DHCP. Use of static IP addressing shall also be supported.

G. Web server will have adequate capacity to store and serve 500 user defined graphics, and to archive not less than 12 consecutive months of historical data for all I/O points connected to system, including alarms, event histories, transaction logs, trends and other information indicated.

H. Server(s) shall use IT industry-standard database platforms such as Microsoft SQL Server and Microsoft Data Engine (MSDE). The Web browser client shall support Sun Microsystems Java 2 (JRE 1.4.0 or higher) plug-in.

I. Functionality:

1. A minimum of 30 users shall be able to utilize the system device at the same time. Operators with proper security shall be able to:

   a. View graphical information about a facility, change setpoints, perform overrides.
   b. View and change schedules.
   c. View and acknowledge alarms.
   d. View historical information.

2. Operators must enter in a valid unique user name and password to access the system.
3. Operator security: The Web server shall include industry standard security protocols to prohibit access by unauthorized users over the World Wide Web. Provide firewalls between server Web and networks with password protection for access to server from Web server.
4. The web server shall display the same graphics that have been created for the Operators Workstation.
5. Operators with proper access shall be able to configure the web server using their web browser.

J. Web Server Hardware.

1. Provide a solid-state web server. This device may not contain any moving parts including but not limited to cooling fans, disk drives, CD Rom drives etc.
2. All user entered information (web pages, security, etc.) shall be stored in non-volatile memory. System operational information and clock functions shall be backed up by battery or other device for a minimum of 72 hours.

2.13 SYSTEM SOFTWARE

A. System Software Minimum Requirements:

1. Provide all software required for efficient operation of all the automatic system functions required by this specification. Software shall be modular in design for flexibility in expansion or revision of the system. It is the intent of this specification to require provisions of a system which can be fully utilized by individuals with no, or limited, previous exposure to PC's and programming techniques and languages.
2. The software in the system shall consist of both "firmware" resident in the PCU's and "software" resident in the operator work stations. The architecture of the system, and the application software/firmware shall be distributed with no single system component responsible for a control function for the entire Controller LAN. Each PCU shall contain the necessary firmware and I/O capability to function independently in case of a network failure. No active energy management or environmental control sequences shall be resident in the PC work stations. All PC work stations shall be removable from the system without loss of control function - only alarm monitoring, long term history collection, and operator monitor/command/edit functions would be lost.
3. Software: **All software upgrades applicable to the system and offered by the manufacturer / contractor for this system shall be provided at no cost to the Owner throughout the warranty period.** This no-cost upgrade shall include installation, programming, modification to field equipment, data base revisions, etc. all as appropriate.
4. Real-time multitasking and multiuser 32- or 64-bit operating system that allows concurrent multiple operator workstations operating and concurrent execution of multiple real-time programs and custom program development.

5. Operating system shall be capable of operating DOS and Microsoft Windows applications.
6. Database management software shall manage all data on an integrated and non-redundant basis. Additions and deletions to database shall be without detriment to existing data. Include cross linkages so no data required by a program can be deleted by an operator until that data have been deleted from respective programs.
7. Network communications software shall manage and control multiple network communications to provide exchange of global information and execution of global programs.
8. Operator interface software shall include day-to-day operator transaction processing, alarm and report handling, operator privilege level and data segregation control, custom programming, and online data modification capability.
9. Scheduling software shall schedule centrally based time and event, temporary, and exception day programs.

B. Basic Interface Description

1. Operator workstation interface software shall minimize operator training through the use of English language prompting, English language point identification and industry standard PC application software. The software shall provide, as a minimum, the following functionality: a. Graphical viewing and control of environment
2. Scheduling and override of building operations
3. Collection and analysis of historical data
4. Definition and construction of dynamic color graphic displays
5. Editing, programming, storage and downloading of controller databases
6. Provide a graphical user interface which shall minimize the use of a typewriter style keyboard through the use of a mouse or similar pointing device and "point and click" approach to menu selection. Users shall be able to start and stop equipment or change setpoints from graphical displays through the use of a mouse or similar pointing device.

    a. Provide functionality such that all operations can also be performed using the keyboard as a backup interface device.
    b. Provide additional capability that allows at least 10 special function keys to perform often used operations.

7. The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. The mouse shall be used to quickly select and switch between multiple applications. This shall be accomplished through the use of Microsoft Windows or similar industry standard software that supports concurrent viewing and controlling of systems operations. a. Provide functionality such that any of the following may be performed simultaneously, and in any combination, via user-sized windows:

    a. Dynamic color graphics and graphic control
    b. Alarm management coordinated with section 2.04.E.
    c. Time-of-day scheduling
    d. Trend data definition and presentation
    e. Graphic definition
    f. Graphic construction

8. If the software is unable to display several different types of displays at the same time, the EMS contractor shall provide at least two operator workstations.

9. Multiple-level password access protection (minimum of five levels of access) shall be provided to allow the user/manager to limit workstation control, display and data base manipulation capabilities as he deems appropriate for each user, based upon an assigned password.

    a. Level 1 = View all applications, but perform no database modifications
    b. Level 2 = Custodial privileges plus the ability to acknowledge alarms
    c. Level 3 = All privileges except system configuration
    d. Level 4 = All configuration privileges except passwords
    e. Level 5 = All privileges

10. A minimum of 50 unique passwords, including user initials, shall be supported.
11. Operators will be able to perform only those commands available for their respective passwords. Menu selections displayed shall be limited to only those items defined for the access level of the password used to log-on.
    a. The system shall automatically generate a report of log-on/log-off time and system activity for each user.
    b. User-definable, automatic log-off timers of from 5 to 60 minutes shall be provided to prevent operators from inadvertently leaving devices on-line.

12. Software shall allow the operator to perform commands including, but not limited to, the following:

    a. Start-up or shutdown selected equipment
    b. Adjust setpoints
    c. Add/modify/delete time programming
    d. Enable/disable process execution
    e. Lock/unlock alarm reporting for points
    f. Enable/disable totalization for points
    g. Enable/disable trending for points
    h. Override PID loop setpoints
    i. Enter temporary override schedules
    j. Define holiday schedules
    k. Change time/date
    l. Automatic daylight savings time adjustments
    m. Enter/modify analog alarm limits
    n. Enter/modify analog warning limits
    o. View limits
    p. Enable/disable demand limiting for each meter
    q. Enable/disable duty cycle for each load

C. Reports and Logs:

1. Reports shall be generated and directed to either CRT displays, printers or disk. As a minimum, the system shall allow the user to easily obtain the following types of reports:

    a. A general listing of all points in the network
    b. List of all points currently in alarm
    c. List of all points currently in override status
    d. List of all disabled points
    e. List of all points currently locked out
    f. DDC Controller trend overflow warning
    g. List all weekly schedules

h. List of holiday programming
i. List of limits and deadbands.
j. Summaries shall be provided for specific points, for a logical point group, for a user-selected group or groups or for the entire facility without restriction due to the hardware configuration of the building automation system. Under no conditions shall the operator need to specify the address of the hardware controller to obtain system information.

2. Include reporting software package that allows operator to select, modify, or create reports using DDC system I/O point data available.
3. Each report shall be definable as to data content, format, interval and date.
4. Report data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on server for historical reporting.
5. Operator shall be able to obtain real-time logs of all I/O points by type or status, such as alarm, point lockout, or normal.
6. Reports and logs shall be stored on [workstation] [and] [server] hard drives in a format that is readily accessible by other standard software applications, including spreadsheets and word processing.
7. Reports and logs shall be readily printed and set to be printed either on operator command or at a specific time each day.

D. Standard Reports: Standard DDC system reports shall be provided and operator shall be able to customize reports later.

1. All I/O: With current status and values.
2. Alarm: All current alarms, except those in alarm lockout.
3. Disabled I/O: All I/O points that are disabled.
4. Alarm Lockout I/O: All I/O points in alarm lockout, whether manual or automatic.
5. Alarm Lockout I/O in Alarm: All I/O in alarm lockout that are currently in alarm.
6. Alarm history.

E. Custom Reports: Operator shall be able to easily define any system data into a daily, weekly, monthly, or annual report.

F. Scheduling:

1. Monthly calendars for a 24-month period shall be provided which allow for simplified scheduling of holidays and special days in advance.
2. Weekly schedules shall be provided for each building zone or piece of equipment with a specific occupancy schedule.
3. Zone schedules shall be provided for each building zone. Each commandable point may have a unique schedule of operation relative to the zone' s occupancy schedule, allowing for sequential starting and control of equipment within the zone.
4. Holidays and special days shall be user-selected with the pointing device and shall automatically reschedule equipment operation.
5. Collection and Analysis of Historical Data

a. Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals or changes of value, both of which shall be user definable. Trend data may be stored on hard disk for future diagnostics and reporting.

b. Trend data report graphics shall be provided to allow the user to view all trended point data. Reports may be customized to include individual points or pre-defined groups of at least 6 points. Provide additional functionality to allow any trended data to be transferred easily to an off-the-shelf spreadsheet package such as Lotus 1-2-3a. This shall allow the user to perform custom calculations such as energy usage, equipment efficiency and energy costs and shall allow for generation of these reports on high-quality plots, graphs and charts.

2.14 GRAPHICS

A. Provide Central Operator's Station with software and hardware as needed to meet requirements specified herein. Graphics are to be online programmable and under password control.

B. System shall be provided with complete color graphics software package, such that graphics can be created by user from time of software installation, without need for additional hardware or software. Each operator work station shall support not less than 1,000 separate graphic pages. Contractor shall include developed graphics as approved by the Owner's representative for this project.

C. Graphics program shall be fully user interactive, full color, incorporating the following capabilities:

1. Up to 50 dynamic points of data per graphic page
2. Animated objects for discrete points to illustrate point status
3. On-line 'draw' utility
4. Ability to import .PCX or .DXF file format graphics developed in third party programs
5. "Page Linking" such that it is possible to "zoom" into a specific AHU or any other page through a sequence of graphics without using anything but the system mouse.
6. Generate, store, and retrieve library symbols for use in generating graphic pages.
7. Fifty (50) dynamic points of data per graphic page.
8. Pixel level resolution. Graphics will be displayed on EGA monitors with a 640 X 350 resolution, and on VGA monitors with a 640 X 480 resolution, minimum. Color selections will be made from a color bar consisting of 16 colors, with adjacent text description.
9. Animated objects for discrete points (i.e., when a pump starts, the pipe fills with water or when a damper shuts it goes closed on the screen).
10. Analog bar graphs for analog points. The operator shall be able to locate up to 60 bar graphs per graphic page, with options as to bar graph color, dimensions, horizontal/vertical orientation, and limit values.

D. Provide for import of .PCX file format graphics developed in third party programs such as Paintbrush. Such imported graphics shall be used as a "backdrop", so that all other dynamic and animated system features may be superimposed on this graphic. Similarly, it shall be possible to import CAD type drawings, by first converting the CAD drawing from .DXF format to .PCX format.

E. The EMS contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g., fans, cooling coils, filters, dampers, etc.), complete mechanical systems (e.g., constant volume-terminal reheat, VAV, etc.) and electrical symbols, so that Owner may develop graphics.

F. The graphic development package shall use a mouse or similar pointing device in conjunction with a drawing program to allow the user to perform the following:

1. Define symbols
2. Position and size symbols
3. Define background screens
4. Define connecting lines and curves
5. Locate, orient and size descriptive text
6. Define and display colors for all elements
7. Establish correlation between symbols or text and associated system points or other displays

G. System shall allow graphical displays to be created to represent any logical grouping of system points or calculated data based upon building function, mechanical system, building layout or any other logical grouping of points which aids the operator in the analysis of the facility. To accomplish this, the user shall be able to build graphic displays that include point data from multiple DCU Controllers including Terminal Equipment Controllers used or DDC equipment.

H. System Configuration and Definition

1. All temperature and equipment control strategies and energy management routines shall be definable by the operator. System definition and modification procedures shall not interfere with normal system operation and control.
2. The system shall be provided complete with all equipment and documentation necessary to allow an operator to independently perform the following functions:

    a. Add/delete/modify stand-alone DDC Controller panels
    b. Add/delete/modify operator workstations
    c. Add/delete/modify application specific controllers
    d. Add/delete/modify points of any type and all associated point parameters and tuning constants
    e. Add/delete/modify alarm reporting definition for points
    f. Add/delete/modify control loops
    g. Add/delete/modify energy management applications
    h. Add/delete/modify time and calendar-based programming
    i. Add/delete/modify totalization for points
    j. Add/delete/modify historical data trending for points
    k. Add/delete/modify custom control processes
    l. Add/delete/modify any and all graphic displays, symbols and cross-reference to point data
    m. Add/delete/modify dial-up telecommunication definition
    n. Add/delete/modify all operator passwords. Add/delete/modify alarm messages

3. Definition of operator device characteristics, DCU Controllers individual points, applications and control sequences shall be performed using instructive prompting software. a. Libraries of standard application modules such as temperature, humidity and static pressure control may be used as "building blocks" in defining or creating new control sequences. In addition, the user shall have the capability to easily create and archive new modules and control sequences as desired via a word processing type format. Provide a library of standard forms to facilitate definition of point characteristics. Forms shall be self prompting and incorporate a fill-in-the-blank approach for definition of all parameters. The system shall immediately detect an improper entry and automatically display an error message explaining the nature of the mistake.
4. Inputs and outputs for any process shall not be restricted to a single DCU Controller, but shall be able to include data from any and all other network panels to allow the development of network-wide control strategies. Processes shall also allow the operator

to use the results of one process as the input to any number of other processes (cascading).

5. Provide the capability to backup and store all system databases on the workstation hard disk. In addition, all database changes shall be performed while the workstation is on-line without disrupting other system operations. Changes shall be automatically recorded and downloaded to the appropriate DCU Controller. Similarly, changes made at the DCU Controllers shall be automatically uploaded to the workstation, ensuring system continuity. The user shall also have the option to selectively download changes as desired.
6. Provide context-sensitive help menus to provide instructions appropriate with operations and applications currently being performed.

I. Alarm Handling Software:

1. Include alarm handling software to report all alarm conditions monitored and transmitted through DDC controllers, gateways, and other network devices.
2. Alarm handling shall be active at all times to ensure that alarms are processed even if an operator is not currently signed on to DDC system.
3. Alarms display shall include the following:

    a. Indication of alarm condition such as "Abnormal Off," "Hi Alarm," and "Low Alarm."
    b. "Analog Value" or "Status" group and point identification with native language point descriptor such as "Space Temperature, Building 110, 2nd Floor, Room 212."
    c. Discrete per point alarm action message, such as "Call Maintenance Dept. Ext-5561."
    d. Include extended message capability to allow assignment and printing of extended action messages. Capability shall be operator programmable and assignable on a per point basis.

4. Alarms shall be directed to appropriate operator workstations, printers, and individual operators by privilege level and segregation assignments.
5. Send e-mail, page, text and voice messages to designated operators for critical alarms.
6. Alarms shall be categorized and processed by class.

    a. Class 1:

        1) Associated with fire, security and other extremely critical equipment monitoring functions; have alarm, trouble, return to normal, and acknowledge conditions printed and displayed.
        2) Unacknowledged alarms to be placed in unacknowledged alarm buffer.
        3) All conditions shall cause an audible sound and shall require individual acknowledgment to silence audible sound.

    b. Class 2:

        1) Critical, but not life-safety related, and processed same as Class 1 alarms, except do not require individual acknowledgment.
        2) Acknowledgement may be through a multiple alarm acknowledgment.

    c. Class 3:

1) General alarms; printed, displayed and placed in unacknowledged alarm buffer queues.
2) Each new alarm received shall cause an audible sound. Audible sound shall be silenced by "acknowledging" alarm or by pressing a "silence" key.
3) Acknowledgement of queued alarms shall be either on an individual basis or through a multiple alarm acknowledgement.
4) Alarms returning to normal condition shall be printed and not cause an audible sound or require acknowledgment.

d. Class 4:

1) Routine maintenance or other types of warning alarms.
2) Alarms to be printed only, with no display, no audible sound and no acknowledgment required.

7. Include an unacknowledged alarm indicator on display to alert operator that there are unacknowledged alarms in system. Operator shall be able to acknowledge alarms on an individual basis or through a multiple alarm acknowledge key, depending on alarm class.
8. To ensure that no alarm records are lost, it shall be possible to assign a backup printer to accept alarms in case of failure of primary printer.

J. Trends:

1. Trend all I/O point present values, set points, and other parameters indicated for trending.
2. Trends shall be associated into groups, and a trend report shall be set up for each group.
3. Trends shall be stored within DDC controller and uploaded to hard drives automatically on reaching 75% of DDC controller buffer limit, or by operator request, or by archiving time schedule.
4. Trend intervals shall be operator selectable from 10 seconds up to 60 minutes. Set trend intervals for each I/O point after review with Owner and CxA.
5. When drive storage memory is full, most recent data shall overwrite oldest data.
6. Archived and real-time trend data shall be available for viewing numerically and graphically by operators.

2.15 GRAPHICS PAGES LAYOUT AND QUALITY

A. All proposed graphics pages are to be submitted to engineer for approval prior to uploading to system.

1. After uploading graphics pages to system, cooperate with Engineer and Owner to fine tune graphics pages with respect to layout, formatting, points displayed, etc.

B. Schematic representation of all equipment and system graphics must be accurate and representative of the actual installed field conditions, such as respective locations of indicated devices, air flow patterns, etc. Changes in the field installation, variances in equipment installed versus equipment specified, etc., will require controls subcontractor to revise graphics.

C. Control and monitored points for any system may be presented solely in tabular form, without graphic representation, only with prior approval of Engineer. Otherwise, a graphical page showing system schematic must be provided for each system.

D. Where Modbus or Bacnet interface with equipment controllers is provided, all readable / writeable points available must be accessible via BAS. Of these total number of points, a

limited, select number of critical points must be displayed on a dedicated graphics page, accessible by clicking on the schematic of the equipment/system with which associated.

1. Provide Engineer with latest updated list of Bacnet or Modbus points, names and addresses from equipment manufacturer.

    a. Where selected Bacnet points to display are not designated in drawings or these specifications, budget for displaying up to 24 such points to be selected by Engineer and/or Owner from the latest updated list of Bacnet or Modbus points for equipment being monitored.

2. Equipment manufacturer's point names are often unclear or ambiguous as to what they actually reference. Contractor will modify any point text descriptor per Engineer and/or Owner direction so than the meaning is absolutely clear.

E. Building floor plans

1. Building floor plans are to indicate clearly separate HVAC zones. Distinction between HVAC zones may be illustrated by a variety of means acceptable to Engineer, including darker lines surrounding the zone, color variations, superimposed duct layouts, etc. A clear indication of the extent of floor plan served by each unit must be given. Depending upon temperature-dependent color-coding
2. Engineer endeavors to provide current floor layouts in contract drawings. However, Owner may modify buildings by adding doors or walls, etc. If necessary due to changes in building floor plans, revise graphics to show accurate wall and door locations.
3. All building floor plans must indicate final room numbers (exceptions to include only very small rooms which have no thermostat, such as janitor's closets, etc.). Prior to producing floor plan graphics, confirm in writing from Owner and/or Architect what final room numbers are. Graphics display for special purpose rooms, such as Gyms, Cafeterias, Band Halls, etc., must show this generic name of room in addition to room number (if it is indicated on drawings).
4. Locations of all major equipment (VAV boxes, air handlers, exhaust fans, chillers, boilers, pumps, etc.) are to be indicated on floor plans, along with a clear indication of the area each serves.
5. Floor plan graphic of each zone is to be color-coded, displaying different colors to show space conditions are within or out of specified temperature range.
6. All temperature, relative humidity, and CO2 sensors locations are to be indicated on floor plans in actual position where installed. A clear indication of which unit(s) is controlled by that sensor must be given (such as by a dashed or curved line connecting the two).
7. Actual readings of temperature, relative humidity, and CO2 sensors are to be indicated on floor plans.

F. Graphics text

1. All text displayed on graphic must be large enough to be clearly and easily readable. Font colors must be chosen for good contrast against background so that they are clearly and easily readable. Super-position of separate text lines overlapping one another or overlapping other iconography is not acceptable.
2. Text wording for labeled points must be clear and easily understood to any person with moderate experience with HVAC systems.
3. Not all text must have identical font and style on each individual graphic page. Use of varying size and style is required and helpful in identifying and distinguishing important

values. However, use consistent font size and style for displaying parameters of similar nature or importance.

4. Text for all parameters must be so positioned on graphics screens that it is unquestionably obvious to what symbols, equipment, or values it applies. This is typically done by placing the text very close to the item to which it applies. Where graphics prevent this (e.g. where it would be too crowded and therefore unclear), use arrows or lines connecting value to the item.
5. Equipment indicated in graphics must be identified with the precise name as indicated in drawings in order to facilitate cross-referencing between graphics and drawings. Where equipment name has changed or Owner desires it be changed, make such modification on final graphics pages.
6. Symbols for devices such as smoke detectors, cut-out safety switches, filter dP sensors, heating or cooling coils, etc., must be labeled so that it is unambiguously clear what the symbol represents.
7. Spelling on graphics pages must be correct.

G. Specified Points

1. *At a minimum*, every input and output listed as a point in bid documents must be displayed graphically.

H. Units

1. Units for all parameters are to be listed on graphics screens or other screens. Use the following nomenclature, or other only as approved by Engineer.

    a. Commanded state: On/Off or Off/Enable, as appropriate
    b. Variable speed motor (e.g. fan or pump) commanded speed: % of full speed

        1) It is unacceptable to display BAS output signal to VFD when such signal does not correspond to the actual VFD/fan speed. Coordinate closely with VFD programming such that speed indication on BAS screen exactly matches actual VFD speed.

    c. Variable speed motor (e.g. fan or pump) speed feedback: % of full speed feedback
    d. Duct static pressure and duct static pressure setpoint: in. WC, or "wc, following by ‘setpoint’ when value displayed is the setpoint
    e. Temperature: ˚F, or deg F, or simply ‘F’

        1) Outside air temperature: OAT
        2) Discharge or supply air temperature: use either DAT or SAT
        3) Return air temperature: RAT

    f. Relative humidity: % RH
    g. Valve or damper analog output commanded position: % open

        1) For cooling tower bypass valves, add descriptive text such as “% open to bypass”)

    h. Valve or damper analog output feeback position: % open / position feedback
    i. CO2 reading and CO2 setpoint: ppm
    j. Hydronic system pressure: psi
    k. Hydronic system differential pressure: psi dP, or psi ΔP
    l. Chiller cooling load: Tons

m. Refrigerant system pressure: psi
n. Alarm state of any point: Alarm / Normal
o. Air flow: CFM
p. Water flow: GPM
q. Light level: fc (footcandles)
r. Filter status: Dirty / Clean for digital, in. WC, or "wc for analog
s. Power and energy: kWh, kW, KVA.

2. For any additional parameters not specifically listed above, use similarly descriptive, standardly accepted units designations, approved by Engineer.
3. Consistent nomenclature for points must be used throughout all graphics pages.
4. Graphics text MUST distinguish between On/Off and Off/Enable digital output points. Typical Off/Enable items include chillers, boilers, DX units, etc. Typical On/Off items include fan motors, pumps, etc. Do not indicate a status or command value of "ON" for equipment that is actually controlled as Off/Enable.
5. **Numerical values for all units are to be displayed to decimal point values truncated to a level commensurate with the accuracy of the sensor.** Unless otherwise noted, display values to the following decimal accuracy:

   a. List to 0 decimal points accuracy: Variable speed drive speed, relative humidity, % valve and damper position, CO2 concentration, water flow, air flow, gallons, kWh, KVA, kW, amps.
   b. List to 1 decimal point accuracy: Temperature sensor inputs, temperature setpoints, duct static pressure, and voltage.
   c. List to 2 decimal point accuracy: Building static pressure.

I. Reset schedules

1. ALL reset schedules specified in operating sequences must be clearly indicated on the screen of the equipment to which it applies. (For example, a chilled water supply temperature reset schedule versus outside air temperature must be listed on the chiller graphic page.) All values in this reset schedule are to be operator adjustable by clicking on the value within the reset schedule.

J. Forced parameters

1. Provide a clear indication on graphic screen when automatic control or readout of ***any*** point (command or status, input or output, analog or digital) has been overridden (usually referred to as being placed in Operator or Forced or Manual mode). This may be done in a variety of ways acceptable to engineer (such as placing a large, bold M next to the point, having the point value flash red, placing a dashed rectangle around it, etc.)
2. The indication of a point being in Forced mode must be placed on the main graphic screen of the equipment such that Operator is not required to access other backup screens to see which points are Forced.

K. Provide navigation icons or "linkages" for major systems pages or major equipment items to allow the operator to switch quickly from one major system or building area screen to another.

L. Indication of equipment Status

1. Graphics must make clear with no ambiguity the meaning of the term "Status" (often as applied to equipment such as boilers and chillers, the meaning is not intuitively clear).

a. When Status indicates presence or absence of an alarm, it must be labeled “Alarm Status”.
b. When Status indicates an actual on/off or operating state of equipment, specifically indicate what status is being provided. For example, if the Status point reads whether the burner is firing or not, it must be labeled “Burner Status”; if the Status point reads whether a chiller compressor is On or not, it must be labeled “Compressor Status”; if the Status point simply indicates whether a piece of equipment has received an Enable command or not, it must be labeled “Status: Equipment Enabled”.

2.16 DDC CONTROLLERS

A. DDC system shall consist of a combination of network controllers, programmable application controllers and application-specific controllers to satisfy performance requirements indicated.

B. DDC controllers shall perform monitoring, control, energy optimization and other requirements indicated.

C. DDC controllers shall use a multitasking, multiuser, real-time digital control microprocessor with a distributed network database and intelligence.

D. Each DDC controller shall be capable of full and complete operation as a completely independent unit and as a part of a DDC system wide distributed network. The digital system controllers shall perform full control automation functions regardless of the condition of communications with the Central Operator's Station.

E. Environment Requirements:

1. Controller hardware shall be suitable for the anticipated ambient conditions.
2. Controllers located in conditioned space shall be rated for operation at 32 to 120 deg F.
3. Controllers located outdoors shall be rated for operation at 32 to 150 deg F.

F. Power and Noise Immunity:

1. Controller shall operate at 90 to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent of nominal voltage.
2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios with up to 5 W of power located within 36 inches (900 mm) of enclosure.

G. DDC Controller Spare Processing Capacity:

1. Include spare processing memory for each controller. RAM, PROM, or EEPROM will implement requirements indicated with the following spare memory:

a. Network Controllers: 50 percent.
b. Programmable Application Controllers: Not less than 50 percent.
c. Application-Specific Controllers: Not less than 50 percent.

2. Memory shall support DDC controller's operating system and database and shall include the following:

a. Monitoring and control.

b. Energy management, operation and optimization applications.
c. Alarm management.
d. Historical trend data of all connected I/O points.
e. Maintenance applications.
f. Operator interfaces.
g. Monitoring of manual overrides.

H. DDC Controller Spare I/O Point Capacity: Include spare I/O point capacity for each controller as follows:

1. Network Controllers:

a. 20 percent of each AI, AO, BI, and BO points connected to controller.
b. Minimum Spare I/O Points per Controller:

1) AIs: Two.
2) AOs: Two.
3) BIs: Two.
4) BOs: Two.

2. Programmable Application Controllers:

a. Minimum Spare I/O Points per Controller:

1) AIs: Two.
2) AOs: Two.
3) BIs: Two.
4) BOs: Two.

3. Application-Specific Controllers:

a. Minimum Spare I/O Points per Controller:

1) AIs: Two.
2) AOs: Two.
3) BIs: Two.
4) BOs: Two.

2.17 NETWORK CONTROLLERS

A. General Network Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. System shall consist of one or more independent, standalone, microprocessor-based network controllers to manage global strategies indicated.
3. Controller shall have enough memory to support its operating system, database, and programming requirements.
4. Data shall be shared between networked controllers and other network devices.
5. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
6. Controllers shall have a real-time clock.

7. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
8. Controllers shall be fully programmable.

B. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

2.18 PROGRAMMABLE APPLICATION CONTROLLERS

A. General Programmable Application Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. Software applications shall reside and operate in controllers. Editing of applications shall occur at operator workstations. Controllers shall be configured to use stored default values to ensure fail-safe operation.
3. Controller shall have enough memory to support its operating system, database, and programming requirements.
4. Data shall be shared between networked controllers and other network devices.
5. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
6. Controllers that perform scheduling shall have a real-time clock.
7. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
8. Controllers shall be fully programmable.
9. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
10. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

2.19 APPLICATION-SPECIFIC CONTROLLERS

A. Description: Microprocessor-based controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. Controllers are not fully user-programmable but are configurable and customizable for operation of equipment they are designed to control.

1. Capable of standalone operation and shall continue to include control functions without being connected to network.
2. Data shall be shared between networked controllers and other network devices.

B. Communication: Application-specific controllers shall communicate with other application-specific controller and devices on network, and to programmable application and network controllers.

2.20 SENSORS & FIELD DEVICES

A. All sensors and field devices shall be of commercial grade quality and shall be installed according to the manufacturer's recommendations. Outdoor damper actuators shall be rated for exterior service and provided in weatherproof UV-inhibited housing.

B. Temperature Sensors (General)
1. All temperature inputs for the automation system shall be derived directly from analog inputs from electronic temperature sensors. Transducing of pneumatic sensor signals shall not be acceptable.
2. Temperature sensing elements shall be RTD type, thermistor type, or solid state sensors, as specified in drawings or points list. All sensors of a particular type shall be from the same manufacturer.
3. Characteristics for temperature sensors:
   a. Interchangeability of +/- 0.2% at the reference temperature.
   b. Time constant response to temperature change shall be less than three seconds per degree F.
   c. Sensors shall be linear, drift free, and require only a one time calibration. Sensing elements shall be factory calibrated.
   d. The sensing elements shall be hermetically sealed.
   e. Additional linearizing, ranging, and lead length compensation may be accomplished in software if required to meet the accuracies specified within.
4. Expected temperature sensor operating range and end to end accuracy, including errors associated with sensor, transmitter (if applicable), leadwire and A/D conversion shall be as follows:

Sensed Element	Expected Oper. Range	Sensor Accuracy
a. Return air	40 to 100˚F	0.5˚F
b. Indoor space temperature	40 to 100˚F	0.5˚F
c. Outside air	0 to 125˚F	0.5˚F

C. Adjustable Limited Range Wall Temperature Sensors (Thermostats)
1. General: All wall sensors installed as part of this project shall have adjustable limited range setpoint adjustment function.
   a. 10K-2-R-SOD (10K, DA, Cool / Warm, OVR). Override option shall be provided.
   b. Setpoint limits shall be adjustable via the COS and password protected.
   c. Unit shall have a built in processor and shall communicate with local controller.
   d. Unit shall have an LCD display for space temperature and on / off state
   e. Unit shall have a password protection function to restrict access to service mode.
   f. Provide extra thermostats: 5 of each type.
2. Following areas shall have sensors with override option in addition to adjustable setpoint range function: all sensors in Administration, Gym.

D. Humidity Sensors: Bulk polymer sensor element.
1. Bulk polymer sensor element. Install humidity sensors in the space and not in ductwork unless specifically noted. Coordinate locations of duct mounted sensors with Engineer.
   a. Accuracy: 5 percent full range with linear output.
   b. Room Sensors: With locking cover matching room thermostats, span of 25 to 90 percent relative humidity.
   c. Duct and Outside-Air Sensors: With element guard and mounting plate.

E. Carbon Dioxide (CO2) sensors:

1. CO2 sensor shall monitor indoor carbon dioxide (CO2) levels in accordance with ASHRAE standard 62-2004. Complete kit shall include optional aspiration box for mounting sensor inside return air duct.
2. Sensor shall have a 4 - 20 mA linear output over a range of 0 - 5000 ppm of CO2. A SPDT shall be provided for local control or alarm output.
3. **Provide sensor with LCD readout.**
4. Power: 24VAC or DC at 400mA max.
5. Measuring range: 0-2000 ppm
6. Accuracy: 40 ppm + 2% of reading
7. Analog output: 4-20 mA
8. Control relay: N.O. SPST, 0.75 amp at 24VAC/VDC
9. Operating temperature: 32° - 122°F
10. Operating humidity: 5-95% non-condensing
11. Calibration adjustment: zero to span
12. Min. req. calibration: One year
13. Unit enclosure: UL fire rated
14. Aspiration box: High impact styrene

F. Equipment operation sensors as follows:
1. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.
2. Electronic Valve/Damper Position Indication: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

G. Equipment on/off control shall use either momentary pulsed relays or magnetically latched relays, as appropriate for the equipment's control starter. Interfacing controls shall be configured such that in its last commanded state. All equipment safeties and interlocks shall remain active, and will not be bypassed by new EMS controls. For motors with VFDs provide On/Off Control as appropriate VFD terminals.

H. Watthour Transducers: Shall have an accuracy of +/- 2.5% at 0.5 power factor to 2.0% at 1 power factor for KW and KWH outputs. Output signals for KW and KWH shall be internally selectable without requiring the changing of current or potential transformers. Current and potential transformers shall be in accordance with ANSI C57.13.

I. Voltage Outputs: Variable voltage outputs shall provide a voltage signal from 0 to 20 volts. All voltage outputs shall be fuse protected against shorts to 120 volts AC and capable of withstanding a short ground indefinitely. All voltage outputs shall be protected against + or - 1500 volts, 50 microseconds transients. Voltage outputs shall have a resolution of 0.1 volts.

J. Current Outputs: Variable current outputs shall be a sinking type and shall provide 0 to 20 milliamps with a resolution of 0.1 mA and a compliance of 20 volts minimum. All current outputs shall be fuse protected to 120 volts AC and protected against + or - 1500 volts, 50 microsecond transients.

K. Pressure Sensors: Pressure sensors and differential pressure sensors shall be piezo-resistive strain-gauge with temperature compensation. Sensors shall be selected to provide linear indication with an adequate span for the application. Sensor shall be 0 - 10 V or 4 - 20 mA. Insure sensors are rated to operate at temperature of sensed media. Sensors shall have an accuracy of 1% of full scale. Sensors shall accept overpressures of at least 120 psig, at any port, without damaging the sensor.

L. Motor On/Off Status: Unless otherwise specified, status shall be proven using current sensing relays connected at VFDs and calibrated for minimal operating speed.

M. Hardware Overrides: A three position manual override switch shall allow selection of the ON, OFF, or AUTO outputs state for each output point. In addition, all analog output points shall be equipped with an override potentiometer to allow manual adjustment of the analog output signal over its full range, when the 3 position manual override switch is placed in the ON position.

N. Damper Actuators
1. Electronic direct-coupled actuation shall be provided.
2. The actuator shall be direct-coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The fastening clamp assemble shall be of a 'V' bolt design with associated 'V' shaped toothed cradle attaching to the shaft for maximum strength and eliminating slippage. Spring return actuators shall have a 'V' clamp assembly of sufficient size to be directly mounted to an integral jackshaft of up to 1.05 inches when the damper is constructed in this manner. Single bolt or screw type fasteners are not acceptable.
3. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the entire rotation of the actuator. Mechanical end switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable.
4. For power failure/safety applications, an internal mechanical spring return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe operation are not acceptable.
5. All spring return actuators shall be capable of both clockwise or counterclockwise spring return operation by simply changing the mounting orientation.
6. Proportional actuators shall accept a 0 to 10VDC or 0 to 20mA control input and provide a 2 to 10VDC or 4 to 20mA operating range. An actuator capable of accepting a pulse width modulating control signal and providing full proportional operation of the damper is acceptable. All actuators shall provide a 2 to 10VDC position feedback signal.
7. All 24VAC/DC actuators shall operate on Class 2 wiring and shall not require more than 10VA for AC or more than 8 watts for DC applications. Actuators operating on 120VAC power shall not require more than 10VA. Actuators operating on 230VAC shall not require more than 11VA.
8. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb torque shall have a manual crank for this purpose.
9. All modulating actuators shall have an external, built-in switch to allow reversing direction of rotation.
10. Actuators shall be provided with a conduit fitting and a minimum 3ft electrical cable and shall be pre wired to eliminate the necessity of opening the actuator housing to make electrical connections.
11. Actuators shall be Underwriters Laboratories Standard 873 listed and Canadian Standards Association Class 4813 02 certified as meeting correct safety requirements and recognized industry standards.
12. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque and shall have a 2-year manufacturer's warranty, starting from the date of installation. Manufacturer shall be ISO9001 certified.

O. Field Testing and Programming Equipment: A portable laptop or notebook computer shall interface via standard push-in connection at an asynchronous serial port located at the Control modules and at selected enhanced zone temperature sensors as indicated on project plans. This portable unit shall be capable of full global communications with all Control modules connected

within the respective network and shall provide functionally identical user interface to the Workstation, in non-graphic format. Units shall be able to interrogate all points and alter all programming.

2.21 ENCLOSURES

A. General Enclosure Requirements:

1. House each controller and associated control accessories in an enclosure. Enclosure shall serve as central tie-in point for control devices such as switches, transmitters, transducers, power supplies and transformers. Do not house more than one controller in a single enclosure.
2. Include enclosure door with key locking mechanism. Key locks alike for all enclosures and include one pair of keys per enclosure.
3. Enclosures shall be NRTL listed according to UL 508A.
4. Enclosures constructed of steel, finished inside and out with polyester powder coating electrostatically applied and then baked to bond to substrate.
5. Hinged door full size of front face of enclosure and supported using:

    a. Enclosures sizes less than 36 in. (900 mm) tall: Multiple butt hinges.
    b. Enclosures sizes 36 in. (900 mm) tall and larger: Continuous piano hinges.

B. Internal Arrangement:

1. Internal layout of enclosure shall group and protect components associated with a controller, but not an integral part of controller.
2. Arrange layout to group similar products together.
3. Include a barrier between line-voltage and low-voltage electrical and electronic products.
4. Factory or shop install products, tubing, cabling and wiring complying with requirements and standards indicated.
5. Terminate field cable and wire using heavy-duty terminal blocks.
6. Include spade lugs for stranded cable and wire.
7. Install a maximum of two wires on each side of a terminal.
8. Include enclosure field power supply with a toggle-type switch located at entrance inside enclosure to disconnect power.
9. Include enclosure with a line-voltage nominal 20-A GFCI duplex receptacle for service and testing tools. Wire receptacle on hot side of enclosure disconnect switch and include with a 5-A circuit breaker.
10. Mount products within enclosure on removable internal panel(s).
11. Include products mounted in enclosures with engraved, laminated phenolic nameplates (black letters on a white background). The nameplates shall have at least 1/4-inch- (6-mm-) high lettering.
12. Route tubing cable and wire located inside enclosure within a raceway with a continuous removable cover.

C. Environmental Requirements:

1. Evaluate temperature and humidity requirements of each product to be installed within each enclosure.
2. Calculate enclosure internal operating temperature considering heat dissipation of all products installed within enclosure and ambient effects (solar, conduction and wind) on enclosure.

3. Where required by application, include temperature-controlled electrical heat to maintain inside of enclosure above minimum operating temperature of product with most stringent requirement.
4. Where required by application, include temperature-controlled ventilation fans with filtered louver(s) to maintain inside of enclosure below maximum operating temperature of product with most stringent requirement.
5. Include temperature-controlled cooling within the enclosure for applications where ventilation fans cannot maintain inside temperature of enclosure below maximum operating temperature of product with most stringent requirement.
6. Where required by application, include humidity-controlled electric dehumidifier or cooling to maintain inside of enclosure below maximum relative humidity of product with most stringent requirement and to prevent surface condensation within enclosure.

2.22 RELAYS

A. All:

1. Heavy duty, rated for at least 10 A at 250-V ac and 60 Hz.
2. Construct the contacts of either silver cadmium oxide or gold.
3. Relay enclosed in a dust-tight cover.
4. Coil transient suppression to limit transients to non-damaging levels.
5. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
6. Mechanical Life: At least 10 million cycles.
7. Electrical Life: At least 100,000 cycles at rated load.
8. Timing Ranges: Multiple ranges from 0.1 seconds to 100 minutes.
9. Timing Ranges, where applicable: Multiple ranges from 0.1 seconds to 100 minutes.
10. Repeatability: Within 2 percent.
11. Recycle Time: 45 ms.
12. Minimum Pulse Width Control: 50 ms.
13. Power Consumption: 5 VA or less at 120-V ac.
14. Ambient Operating Temperatures: Minus 40 to 115 deg F (Minus 40 to 46 deg C).
15. General-Purpose Relays: With LED indication and a manual reset and push-to-test button.
16. Multifunction Time-Delay Relays: With knob and dial scale for setting delay time.

B. Current Sensing Relay:

1. Monitors ac current.
2. Independent adjustable controls for pickup and dropout current. Choose relay size to be able to read smallest current from motor at lowest speed.
3. Energized when supply voltage is present and current is above pickup setting.
4. De-energizes when monitored current is below dropout current.
5. Dropout current adjustable from 50 to 95 percent of pickup current.
6. Include a current transformer, if required for application.
7. House current sensing relay and current transformer in its own enclosure. Use NEMA 250, Type 12 enclosure for indoors and NEMA 250, Type 4 for outdoors.

2.23 UNINTERRUPTABLE POWER SUPPLY (UPS) UNITS

A. 250 through 1000 VA:

1. UPS units shall provide continuous, regulated output power without using their batteries during brown-out, surge, and spike conditions.
2. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.
3. UPS shall provide up to 15 minutes of battery power.
4. Performance:

    a. Input Voltage: Single phase, 120- or 230-V ac, compatible with field power source.
    b. Load Power Factor Range (Crest Factor): 0.65 to 1.0.
    c. Output Voltage: 101- to 132-V ac, while input voltage varies between 89 and 152-V ac.
    d. On Battery Output Voltage: Sine wave.
    e. Inverter overload capacity shall be minimum 150 percent for 30 seconds.
    f. Recharge time shall be a maximum of six hours to 90 percent capacity after full discharge to cutoff.
    g. Transfer Time: 6 ms.
    h. Surge Voltage Withstand Capacity: IEEE C62.41, Categories A and B; 6 kV/200 and 500 A; 100-kHz ringwave.

5. UPS shall be automatic during fault or overload conditions.
6. Include front panel with power switch and visual indication of power, battery, fault and temperature.

2.24 SURGE PROTECTION

A. Zener diodes, silicone avalanche diode, optical isolation, varistors, or combination thereof.

B. Transient protection
1. Communications LAN:
    a. Provide surge protection equipment sized specifically for expected operating current of LAN.
    b. Exceeds severity level 4 of IEC 801-4.
    c. Operating voltage: 12 volts.
    d. Maximum operating current: 200 mA
    e. Clamping action turn-on: 14.3 volts
    f. Maximum clamping at 2 kW (8 x 20 microsecond wave): 22 volts
    g. Maximum surge voltage: 20 kV
    h. Maximum surge current (8 x 20 microsecond wave): 2.5 kA
    i. Current leakage at perating voltage: 5 microamps
    j. As manufactured by Surge Control Limited, SPR series, or approved equal.
2. Power supply:
    a. Provide surge protection equipment sized specifically for expected operating current of DDC controller.
    b. Exceed recommendations for ANSI / IEEE C62.41-1991 Categories A3 and B3 and UL1449.
    c. Design such that suppressor does not "wear out" with repeated surges.
    d. CSA certified and UL recognized.
    e. EMI / RFI filtering.
    f. Differential and common mode suppression and filtering.
    g. Less than 5 nanosecond response time.
    h. Maximum transient voltage 6 kV.

i. Maximum transient current 3 kA.
j. Minimum clamping turn-on, 210 volts.
k. Maximum clamping voltage, (l-test):
    1) line to neutral — 245 volts.
    2) line to ground — 245 volts.
    3) neutral to ground — 245 volts.
l. Maximum clamping voltage @ 3 kA:
    1) line to neutral — 325 volts.
    2) line to ground — 430 volts.
    3) neutral to ground — 430 volts.
m. As manufactured by Surge Control Limited, SPP-1200 series, or approved equal.

C. Protective devices shall be continuous duty, automatic and self restoring.

2.25 CONTROL WIRE AND CABLE

A. 7/24 soft annealed copper strand with a 2- to 2.5-inch (50- to 65-mm) lay.

B. Plenum rated LAN and Communication Cable complying with NFPA 70 and DDC system manufacturer requirements for network being installed.

2.26 CONTROL POWER WIRING AND RACEWAYS

A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.

B. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" electrical power conductors and cables.

2.27 IDENTIFICATION

A. Provide engraved phenolic tag, fastened with drive pins with min. 0.5" high white lettering on black background, bearing unique identification nomenclature for control equipment and devices.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Schedule and attend conference at location of owner's choosing. Mandatory attendees include representatives from BAS contractor, Owner, Engineer, and Commissioning Authority.

3.2 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify compatibility with and suitability of substrates. Examine roughing-in for products to verify actual locations of connections before installation. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.

B. Prepare written report listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 DDC SYSTEM INTERFACE WITH OTHER SYSTEMS AND EQUIPMENT

A. Coordinate with Owner for provision of required communication infrastructure that is Owner's responsibility, including data drops, IP addresses, etc.

B. Communication Interface to Equipment with Integral Controls: DDC system shall have communication interface with equipment having integral controls and having a communication interface for remote monitoring or control. Reference drawings for equipment to be connected.

3.4 GENERAL INSTALLATION REQUIREMENTS

A. The I/O Summary on the drawings is provided as a list of the minimum points required. Provide all controls points, temperature sensors, relays, actuators, and devices necessary to achieve operational sequences at no additional cost to the Owner, whether explicitly called for or not in this specification. Coordinate with all sub-contractors to ensure all items are provided and installed.

B. Install in accordance with manufacturer's instructions.

C. Controls Contractor is responsible for complete operational installation of system, including, but not limited to the following:
1. Electrical power supply to all control system components, including but not limited to; controllers, actuators, sensors, from dedicated circuits in electrical panels.
2. Complete installation of duct-mounted components, including but not limited to: temperature, relative humidity, pressure, and CO2 sensors, and dampers/actuators.
3. Complete installation of pipe-mounted components, including but not limited to: control valves and actuators, temperature sensors, pressure sensors.

D. All electrical material and installation shall be in accordance with local applicable codes and requirements of Division 26. All automation system equipment supplied shall be provided with adequate grounding in accordance with the manufacturer's specifications and suggested engineering applications procedures. These requirements shall include, but not be limited to:
1. A "clean earth ground" for all FCUs and central operator's station.
2. No "ground mixing" between equipment components.
3. Insulation of all panels from metal conduits.
4. Equal-potential grounding for equipment where required.

E. Identification:

1. Provide a permanent, stick-on tape marker on the inside cover of the space sensor (e.g. temperature, RH) to identify the name of the HVAC unit associated with the sensor.
2. Provide within each enclosure with a complete set of as-built schematics, tubing, and wiring diagrams and product literature for that particular controller.
3. Label each end of cable, wire and tubing in enclosures following an approved identification system that extends from field I/O connection and all intermediate connections throughout length to controller connection. **Use printed labels, not hand-written.**

4. Identify all controller enclosures with 1/8 inch thick plastic labels not less than 3 x 1.25 inches. Fasten with stainless-steel rivets or self-tapping screws or contact-type permanent adhesive, compatible with label and with substrate

F. Install products to satisfy more stringent of all requirements indicated.

G. Install products level, plumb, parallel, and perpendicular with building construction. Support products, tubing, piping wiring and raceways. Brace products to prevent lateral movement and sway or a break in attachment.

H. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.

I. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

J. Seal penetrations made in fire-rated assemblies and in acoustically rated assemblies in accordance with applicable fire codes.

K. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts and screws with graphite and oil before assembly.

L. Install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.

M. Corrosive Environments:

1. Avoid or limit use of materials in corrosive airstreams and environments, including, but not limited to, the following:

   a. Laboratory exhaust-air streams.
   b. Process exhaust-air streams.

2. When conduit is in contact with a corrosive airstream and environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment. Comply with requirements for installation of raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
3. Where instruments are located in a corrosive airstream and are not corrosive resistant from manufacturer, field install products in NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.5 CONTROLLER INSTALLATION

A. Quantity and location of network and programmable application controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.

B. Install controllers in enclosures to comply with indicated requirements in a protected location that is easily accessible by operators.

C. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.7 DDC SYSTEM I/O CHECKOUT, ADJUSTMENT, CALIBRATION AND TESTING

A. Prepare and submit a report to Engineer and Commissioning Authority documenting results for checking, adjustment, calibration, testing. Include a description of corrective measures and adjustments made to achieve desire results for each I/O point, control sequence, and system.

B. Sensor Check and Calibration:

1. Calibrate every sensing device, including temperature, relative humidity, pressure, etc. by comparing field-installed sensors to a high accuracy instrument that has been calibrated within the previous 12 months. Calibrate each instrument according to instrument instruction manual supplied by manufacturer. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. (E.g., an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. All field sensors must read to within accuracy range listed in these specifications. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
4. Programmed offsets may be used to a certain degree to adjust sensor readings. Replace all sensors requiring an offset of more than 2F, or 10% RH, or 0.2" air static pressure or 1.5 psig water static, or 50 ppm CO2.
5. Submit a report certifying that every sensor has been calibrated and is reading accurately as a prerequisite for testing by the commissioning authority. List results of each sensor (field-reading versus calibrated instrument reading).

C. Control Damper Checkout:

1. Verify that control dampers are installed correctly for flow direction.
2. Verify that proper blade alignment, either parallel or opposed, has been provided.
3. Verify that damper frame attachment is properly secured and sealed.
4. Verify that actuator wiring is complete, enclosed and connected to correct power source.
5. Stroke and adjust control dampers following manufacturer's recommendation, from 100 percent open to 100 percent closed and back to 100 percent open. Verify that damper blade travel is unobstructed and that damper actuator and linkage attachment is secure.

6. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
7. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

D. Control Valve Checkout:

1. Verify that control valves are installed correctly for flow direction.
2. Verify that valve body attachment is properly secured and sealed.
3. Verify that valve actuator and linkage attachment is secure.
4. Verify that actuator wiring is complete, enclosed and connected to correct power source.
5. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.
6. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open. Verify that valve ball, disc or plug travel is unobstructed.
7. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

E. Meters: Check sensors at zero, 50, and 100 percent of Project design values.

F. Switches: Calibrate switches to make or break contact at set points indicated.

G. Controllers:

1. Verify voltage, phase and hertz.
2. Verify that protection from power surges is installed and functioning.
3. Verify that ground fault protection is installed.
4. If applicable, verify if connected to UPS unit.
5. If applicable, verify if connected to a backup power source.
6. If applicable, verify that power conditioning units, transient voltage suppression and high-frequency noise filter units are installed.
7. Verify that wire and cabling is properly secured to terminals and labeled with unique identification.
8. Verify that spare I/O capacity is provided.
9. Test every I/O point connected to DDC controller to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance. Test every I/O point throughout its full operating range.
10. Test every control loop to verify operation is stable and accurate.
11. Adjust control loop proportional, integral and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
12. Test and adjust every control loop for proper operation according to sequence of operation.
13. Test software and hardware interlocks for proper operation. Correct deficiencies.
14. Operate each analog point at upper, mid, and lower portions of range
15. Exercise each binary point.
16. For every I/O point in DDC system, read and record each value at operator workstation, at DDC controller and at field instrument simultaneously. Value displayed at operator workstation, at DDC controller and at field instrument shall match.

3.8 DDC SYSTEM COMMISSIONING TESTS

A. Provide written request to Commissioning Authority (CxA) for initiation of on-site Functional Testing. Functional Testing will not take place until:

1. System has been thoroughly tested as described in this section under "DDC System I/O Checkout, Adjustment, Calibration, And Testing", and report has been submitted.
2. Certificate of Readiness has been submitted to CxA.

    a. At his discretion, if entire control system has not been completed, CxA may test portions of system which have been completed.

3. Prefunctional Checklists, if required by contract documents, have been submitted to CxA.

B. Contractor shall set up trend logs as requested by the CxA, Engineer, or Owner, without any limits on the number of trends, to assist in testing and verification of system operation.

1. Prior to start of functional testing, set up the following initial trend logs:

    a. DOAS:
        1) OA T and RH: 15 minute readings.
        2) Discharge air temperature (dry bulb, wet bulb, dew point): 15 minute readings.
        3) Commanded fan speed: 15 minute readings.
        4) Commanded cooling/heating stages: 15 minute readings.

    b. VAV air handler (or RTU):
        1) Room temperature: 15 minute readings.
        2) Discharge air temperature: 15 minute readings.
        3) Commanded fan speed: 15 minute readings.
        4) Commanded cooling/heating stages: 15 minute readings.
        5) OA damper position: Each 5% change of value.
        6) Return air CO2 (where point is specified): 30 minute readings.

C. Contractor shall set up trends and logs as requested by the Engineer or Owner, without any limits on the number of trends.

D. CxA will perform on-site and remote Functional testing as specified in Construction Documents and in accordance with generally accepted commissioning procedures. DDC system shall demonstrate correct operation and accuracy of monitored and controlled points as well as operation capabilities of sequences, logs, trends, reports, specialized control algorithms, diagnostics, and other software indicated. Reference section 019113 "General Commissioning Requirements" for more information.

1. Contractor is to provide a qualified representative, intimately familiar with the project installation and issues, to carry out Functional Testing procedures as directed by CxA, for the duration of Functional Testing.

E. CxA will issue reports to Contractor, in such forms as Commissioning Issues Logs, emails, written reports, detailing items which appear not to be in conformance with construction documents requirements. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.

F. Due to the complexity of control systems and potential for latent defects to go undiscovered during Functional Testing, DDC system or tested portions thereof must operate essentially

trouble-free for a period of 30 consecutive days following Functional Testing before Final Acceptance of system will be granted.

3.9 WARRANTY SERVICE

A. System deficiencies discovered subsequent to Final Acceptance of system will be treated as Warranty items. Under Warranty requirements, address all operating problems, repair or replace worn or defective components, adjust control parameters as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

B. Provide system inspections and reports annually during warranty period; reference paragraph "Warranty Inspections" in this specifications section.

3.10 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning **at Final Acceptance of system**, service agreement shall include software support for two year(s).

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of **Final Acceptance of system**. Upgrading software shall include operating system and new or revised licenses for using software.

3.11 DEMONSTRATION AND TRAINING

A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain DDC system. Owner may send up to 10 persons to attend training. Training shall occur within normal business hours at a mutually agreed on time.

B. Provide not less than **seven** hours of training total, broken up into two 3.5 hour sessions. Provide staggered training schedule as requested by Owner to accommodate Owner personnel schedules.

C. Schedule training with Owner at least four business days before expected Substantial Completion. All training shall occur before Final Acceptance of control system.

D. Organize training sessions into logical groupings of technical content and to reflect different levels of operators having access to system. Plan training sessions to accommodate daily operators, advanced operators, and system managers and administrators.

E. Maintain a training attendee list and sign-in sheet. Sign-in sheet shall include training session number, date and time, instructor name, phone number and e-mail address, and brief description of content to be covered during session. List attendees with columns for name, phone number, e-mail address and a column for attendee signature or initials.

1. For each session, submit a scanned copy (PDF) of circulated sign-in sheet to Owner, Engineer, and Commissioning Authority with 48 hours of end of training session.

F. Provide each attendee with a color hard copy of all training materials and visual presentations. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter.

G. Instructor Requirements:

1. One or multiple qualified instructors, as required, to provide training.
2. Instructors shall have not less than three years of providing instructional training on not less than five past projects with similar DDC system scope and complexity to DDC system installed.

H. On-Site Training:

1. Provide as much of training located on-site as deemed feasible and practical by Owner. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power and data connectivity for instructor and each attendee.
2. Instructor shall provide training materials, projector and other audiovisual equipment used in training.
3. On-site training shall include regular walk-through tours to observe each unique product type installed with hands-on review of operation, calibration and service requirements.
4. Operator workstation shall be used in training, whether Owner's or contractor-provided & via remote web access.

I. Training Content:

1. Basic operation of system.
2. Understanding DDC system architecture and configuration.
3. Understanding each unique product type installed including performance and service requirements for each.
4. Understanding operation of each system and equipment controlled by DDC system including sequences of operation, each unique control algorithm and each unique optimization routine.
5. Operating operator workstations, printers and other peripherals.
6. Logging on and off system.
7. Accessing graphics, reports and alarms.
8. Adjusting and changing set points and time schedules.
9. Recognizing DDC system malfunctions.
10. Understanding content of operation and maintenance manuals, and control drawings.
11. Accessing data from DDC controllers.
12. Operating portable operator workstations.
13. Review of DDC testing results to establish basic understanding of DDC system operating performance and HVAC system limitations as of Substantial Completion.
14. Running each specified report and log, setting up Trend Logs.
15. Displaying and demonstrating each data entry to show Project-specific customizing capability. Demonstrating parameter changes.
16. Stepping through graphics penetration tree, displaying all graphics, demonstrating dynamic updating, and direct access to graphics.
17. Executing digital and analog commands in graphic mode.
18. Demonstrating control loop precision and stability via trend logs of I/O for not less than 10 percent of I/O installed.
19. Demonstrating DDC system performance through trend logs and command tracing.
20. Demonstrating scan, update, and alarm responsiveness.
21. Demonstrating spreadsheet and curve plot software, and its integration with database.
22. Demonstrating on-line user guide, and help function and mail facility.
23. Demonstrating multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.

24. Demonstrating operation of HVAC equipment in normal-off, -on and failed conditions while observing individual equipment, dampers and valves for correct position under each condition.
25. Demonstrating integration into DDC system is able to communicate with DDC controllers or gateways, as applicable.

END OF SECTION 230900

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

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.

B. Related Sections include the following:
1. Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.
2. Division 23 Sections for DOAS and DX RTUs.

1.2 ABBREVIATIONS

A. Abbreviations used in this specifications section:

1. BAS: Building Automation System
2. CO2: Carbon Dioxide
3. DAT: Discharge Air Temperature
4. DCV: Demand Control Ventilation
5. DDC: Direct Digital Control
6. dP: differential Pressure
7. dT: differential Temperature
8. DX: Direct Expansion
9. EF: Exhaust fan
10. OA: Outside Air
11. RH: Relative Humidity
12. RTU: Rooftop Unit
13. TAB: Testing, Adjusting and Balancing

1.3 SUMMARY

A. This Section includes control sequences for HVAC systems, subsystems, and equipment. Provide controls and operating sequences for the following HVAC systems at **Idea Academy, Robindale Campus**:
1. DX packaged dedicated outside air system (DOAS).
   a. DX OAU controlled by solid state controller integral to unit (unitary controller by OAU manufacturer); See Div 23 specs.
   b. BAS shall provide Off/Enable control, allow reset of discharge air temperature and cooling coil temperature setpoints.
   c. Once Enabled, OAU unitary controller provides full control of unit.
   d. All parameters within integral unit controller shall be readable by BAS. Points include but are not limited to operating parameters such as heating, cooling and dehumidification modes, and stages of cooling and heating, position of HGR valve, fan and compressor speeds, and all adjustable setpoints.
2. DX packaged RTUs with DOAS.

a. RTUS controlled by solid state controller integral to units (unitary controller by DX unit manufacturer); See Div 23 specs.
b. System shall provide Off/Enable control, allow reset of space temperature.
c. Once Enabled, DX unit unitary controller provides full control of unit.
d. All parameters within integral unit controller shall be readable by BAS. Points include but are not limited to operating parameters such as heating, cooling modes, and stages of cooling and heating, fan and compressor speeds, and all adjustable setpoints.

3. DX packaged RTUs without DOAS.
   a. RTUS controlled by solid state controller integral to units (unitary controller by DX unit manufacturer); See Div 23 specs.
   b. System shall provide Off/Enable control, allow reset of space temperature, relative humidity, and CO2 setpoints.
   c. Once Enabled, DX unit unitary controller provides full control of unit.
   d. All parameters within integral unit controller shall be readable by BAS. Points include but are not limited to operating parameters such as heating, cooling and dehumidification modes, and stages of cooling and heating, position of HGR valve, fan and compressor speeds, and all adjustable setpoints.
4. Single zone, constant volume FCUs.
5. Exhaust Fan Sequences for all exhaust fans in building.
6. Power monitoring

B. **Prior to bidding**, Controls contractor shall notify general, mechanical and electrical contractor of any work required for operational installation of controls devices that will not be conducted by Controls Contractor. This includes, but is not limited to: installation of controls devices and sensors, as well as any needs for power wiring and/or conduit.

C. A list of the minimum number and type of control points required is given. Provide any additional points, sensors, gateways, interface cards, etc. as required to achieve sequences, whether specifically called for in Points List or not.

D. Provide all hardware, software, and labor required to achieve specified sequences.

E. Units or systems that are grouped together for purposes of sequence description are not meant to be controlled together. Each system shall have its own set of adjustable parameters and will respond only to values (space temperatures for example) associated with it. This means that one unit may be in heating mode while another with similar sequence may be in cooling mode.

1.4 EQUIPMENT TIME SCHEDULES

A. Contractor is responsible for programming schedules for all equipment and systems prior to turning system over to Owner at final system acceptance.

B. **Request Owner's input for on/off and optimum start/stop** (OSS) **programming for all equipment and systems, including both Normal and upcoming Holiday schedules, and Program holiday time schedules as per Owner's direction.**

C. Note that outside air dampers, exhaust fans, or various other specified equipment devices may have independent dedicated time schedule different from the equipment which they serve or are associated with. For example, distinct time schedules may be required for actual Occupied time

(for instance, 8AM to 5:30PM) requiring ventilation versus required equipment start/stop times for comfort.

D. Equipment items having the same Off/Enable or Start/Stop times are not to be software interlinked such that one cannot be changed without changing the other. Each individual equipment item is to have its own individual programmable Off/Enable or Start/Stop scheduling capability.

E. Stagger AHU start times by a minimum of 20 seconds between starts.

F. Unoccupied hours, Off / Enable:
   1. Enable cooling if space air temperature rises above 90˚F (adj.). Disable unit once temperature has fallen to 85˚F (adj.) or below.
   2. Enable heating if space air temperature drops below 45˚F (adj.). Disable unit once temperature has risen to 55˚F (adj.).
   3. Enable cooling if relative humidity rises above 60% (adj.). Disable unit once relative humidity has fallen to 55% (adj.).
   4. Unit shall run for a minimum of 30 min. (adj.) or until specified conditions are satisfied.
   5. Issue Alarm if the unit has been in unoccupied mode for 4 hours (adj) and relative humidity rises above 60% (adj.). This time delay should allow false alarms immediately after units are disabled.
   6. Manual Override: Control may be manually overridden at the zone Thermostat, controller and the COS.
   7. Hardware Interlocks: Controls shall not bypass any safeties or interlocks associated with fire protection shutdown.

1.5 SPACE TEMPERATURE SETPOINTS

A. Temperature and humidity setpoints and operating schedules listed in sequences of operations are initial values, based upon input from Owner's representatives and common industry practice, and are not to be considered as final. Final setpoint and schedules must be programmed as per Owner's direction, and in consultation with and with approval of Owner and/or Engineer and Testing and Balancing firm, regardless of schedules listed in this specification.

B. In consultation with Owner and/or Engineer, and Testing and Balancing firm, make minor revisions to operating sequences which will result in improved operation of systems.

   1. Duct static pressure and hydronic system differential pressure setpoints may be listed in control sequences. These are initial estimated values. They must be modified based upon input from the Testing and Balancing firm to final values which are optimal settings for energy efficient operation of the system.

C. All adjustable setpoint temperature sensors / thermostats are to be software Locked from occupant adjustment, or limited as to the highest heating setpoint and lowest cooling setpoint which building occupants may choose. Initial values are listed in control sequences. Determine final limits in consultation with Owner and Engineer.

D. Whether in Occupied or Unoccupied mode, the active heating setpoint must always be lower than the active cooling setpoint by a minimum of 5F, or higher if called for in sequences. This differential is referred to as the "deadband".

1. With exception of that required for dehumidification, no heating operation is to take place when room temperature is within deadband. Operation of hot water coil or electric reheat is to begin only when room temperature has fallen 1˚F below the heating setpoint.
2. Cooling operation within the deadband must be at an absolute minimum, ie. specified minimum air flow to provide necessary ventilation.

E. Room Temperature Setpoints

1. Allowable range for space temperature setpoints will be limited via control system.

   a. Program temperature setpoints to be set only at the central operator station, and not be adjustable at the zone thermostat.

2. System is expected to maintain room temperature no more than 0.75F above cooling setpoint / below heating setpoint during 'normal' steady-state operating conditions.
3. Unless otherwise noted in drawings or operating sequences described below, program the following room temperature setpoints for all heating and cooling equipment.

   a. Occupied Hours
      1) Cooling setpoint = 74F
      2) Heating setpoint = 69F

   b. Unoccupied Hours
      1) Cooling setpoint = 86F
      2) Heating setpoint = 59F
      3) Run unit for a minimum 20 minutes. Disable unit once temperature has fallen 3F below Cooling or 3F above heating setpoint.

F. Room Relative Humidity (RH) Setpoints

1. System is expected to begin dehumidification sequence at 1% RH above setpoint.
2. Unless otherwise noted in drawings or operating sequences described below, program the following room RH setpoints for all cooling equipment.

   a. Occupied Hours
      1) Cooling RH setpoint = 59%
      2) Run unit for a minimum 20 minutes. Disable dehumidification mode once RH has fallen 3% below setpoint.

   b. Unoccupied Hours
      1) Cooling setpoint = No Unoccupied RH control sequence required

1.6 BACNET CONNECTIONS

A. For equipment to which Bacnet connection is specified:

1. All points readable within equipment Bacnet register are to be communicated to and readable by BAS.

2. Provide a dedicated graphic page to display selected Bacnet points. Navigate to this dedicated graphic by clicking on the equipment icon.

3. The point descriptor text for all Bacnet points displayed on the dedicated Bacnet page are to have clear, unambiguous meaning; simply copying manufacturer's text descriptor may not be acceptable. Supply manufacturer's points text descriptors to Engineer for pre-approval. Revise descriptors if directed by Engineer.

4. Display all values with proper units (deg F, psig, etc.), truncated to decimal point accuracy commensurate with accuracy of sensor.

1.7 OUTDOOR AIR CONDITIONS

A. Outdoor air temperature and relative humidity are to be read from an Engineer-approved web-based weather service such as Accuweather.com. Update conditions at no longer than 30 minute intervals.

B. Display OA temperature and RH conditions on all graphics screens. Display values rounded to nearest whole number.

1.8 GENERAL

A. Individual sequence descriptions may list units to which sequence applies. Contractor must verify equipment quantities and unit types through drawings review and on-site inspections.

B. All setpoints used in controls sequences shall be user adjustable with a minimum of keystrokes.

C. Points lists have been provided as a general guideline, and are not all inclusive. Provide all points required for achievement of operating sequences.

D. All delays shall be operator adjustable. Program for a minimum delay between on/off commands for HVAC equipment to prevent short cycling.

E. Unless noted otherwise, program for minimum VFD speed of 30% of full 60hz speed.

F. Unless noted otherwise, close HVAC unit outside air dampers during all Unoccupied periods.

G. Economizer Operation:

1. Economizer operation is to be based upon a combination of return air temperature and outside air enthalpy.
2. During Occupied periods when system is in cooling mode, place unit in Economizer mode when OA enthalpy is less than 29 Btu/lbm and outside air temperature is less than return air temperature, and modulate outside air dampers to extent required to maintain discharge air temperature or space temperature, as applicable to unit operation.

H. Optimum Start/Stop (OSS):

1. When this feature is Enabled, control system shall automatically calculate the optimal start time for each HVAC system or unit so that comfort conditions will be achieved by the scheduled Occupied time. Control system shall determine the optimal time for equipment shutdown so that comfort conditions may be maintained until scheduled off time with minimal energy use.
2. Coordinate with Owner for information on desired times for comfort conditions and whether OSS is to be Enabled.

I. Interlocks:
1. Hardware: Controls shall not bypass any safeties or interlocks associated with fire protection shutdown.
2. Provide all hardware necessary to achieve software interlocks required for proper system operation, including but not limited to control of dampers and exhaust fans. Coordinate with mechanical and electrical contractors.

J. Damper Actuators:

1. Do not provide physical linkage between OA and return air dampers. Do not control OA and return dampers in complementary fashion (i.e., where sum of % open values of each always add to 100%) unless specifically directed in operating sequence.

K. Operator Station Display: Indicate the following on operator workstation display terminal, as applicable per points list:
1. Building floor plan, indicating individual rooms, thermostat locations, and areas served by each air handler, fan coil unit and rooftop unit.
2. Conditioned space air temperature, all zones.
3. Conditioned space air Base temperature setpoint, all zones.
4. Conditioned space air Actual temperature setpoint, all zones.
5. Distinguish different area(s) served by individual HVAC equipment items by use of color variation or heavy lines on floor plans graphics page.
6. When a control point is in “Test” mode, graphic shall indicate the status such as “test” or “manual”.

1.9 ALARMS

A. Provide minimum / maximum expected input values for all sensors. When any sensor gives a reading outside of these values, initiate an alarm at central operator station, and indicate alarm clearly on graphics screen where the parameter is displayed.

1. Expected maximum / minimum values:

a. Space temperature sensor: 100F / 40F.
b. Outdoor air temperature sensor: 115F / 15F.
c. RH sensor: 105% / 10%.
d. CO2 sensor: 1500 ppm / 390 ppm.

2. When sensor readings are outside expected range, annunciate system alarm.

B. For all HVAC units, register alarms under the following conditions:

1. Discrepancy between actual and commanded state of operation.
2. Discharge air temperature from cooling or heating coil deviates from setpoint by more than 2F for more than 10 minutes.
3. Low mixed air temperature (below 35F).
4. CO2 remains 75 ppm greater than setpoint for 30 consecutive minutes.
5. Unit has tripped on any safety (e.g., high static pressure, freezestat).

C. For all mechanical equipment, register alarms under the following conditions:

1. Discrepancy between actual and commanded state of operation.

D. Register alarms for other equipment (e.g. refrigerant monitor) when monitored alarm contacts close.

E. Provide additional alarm annunciation as described in sub-paragraphs below labeled “Alarms”.

F. Smoke Control: Smoke detector, where existing on HVAC units, stops fan when products of combustion are detected in air stream.

1. Fan will be stopped directly via fire alarm system.
2. BAS is not required to monitor smoke detector status.
3. Stopping of fan by fire alarm system automatically signals alarm due to Command-Status mismatch at BAS.

1.10 CONTROL SEQUENCES FOR DX RTUS WITHOUT DOAS

A. Ensure that provided sequences are coordinated with those specified in Div. 23, Section 237413 Packaged, Outdoor, Central-Station Air-Handling Units. Control sequences shall be similar to those provided for previously provided Carrier hot gas reheat units at other schools in the district.

B. Fan Control: **System** starts fan to run continuously during occupied periods. **System** cycles fan during unoccupied periods.
1. Signal alarm if fan fails to start as commanded.
2. Fan shall vary speed in coordination with compressor staging.

C. Unoccupied Mode Enable / Disable: During unoccupied hours, enable unit operation and control under the conditions listed below. Unit shall run for a minimum of 30 minutes or until space conditions are satisfied.

D. Start-Up Operation: In the order of priority, start-up operation shall be commanded as follows:
1. System shall initiate unit and command to Cooling Mode if space temperature is above cooling setpoint.
2. System shall initiate unit and command to Heating Mode, if space temperature is below heating setpoint.
3. If temperature setpoint is satisfied at start-up, but humidity setpoint is not, System shall initiate unit in Dehumidification Mode.
4. There shall be no exceptions to this.

E. Cooling Mode:

1. System cycles compressor stages to maintain space air temperature setpoint (74F, adj.).
2. Should space RH as measured by system surpass setpoint of 55% RH, activate dehumidification mode. See Div 23 specifications for RTUs.
3. Provide economizer mode to meet new IECC requirements.

F. Dehumidification Mode:
1. If space temperature setpoint is satisfied, but space humidity level is above setpoint (55%, adj.), system shall cycle compressor stages and hot gas reheat valve to maintain space humidity setpoint.
2. Close outside air damper and disable cooling if space temperature drops 1.5°F (adjustable) below space temperature set point.
3. System shall terminate Mode when space humidity drops below setpoint by (5%, adj.), or if system is commanded to Cooling Mode.

G. Heating Mode (Electric):
1. During occupied periods, when fan is running, **system** enables one stage of heat when space temperature drops below heating setpoint (69F, adj.).
2. If a stage is enabled and space temperature continues to remain below setpoint by 2°F for more than 5 minutes, system enables additional heat stage, similarly for additional stages.
3. System disables stages, one at a time, when temperature rises above setpoint by 2°F for more than 5 minutes. Coordinate number of stages with heater.
4. Humidity sensors: Shall be provided by equipment manufacturer.

H. For units that have OA intake, but require constant ventilation: CO2 based DCV is not required. OA dampers will open and close based on dedicated OA damper schedule.

I. Outside-Air Control for other units: CO2 based DCV and OA dampers are required for all units, unless noted otherwise on schedules. Damper position, OA CFM and CO2 setpoint shall be operator adjustable.

1. Unoccupied Periods:
   a. OA Damper Position: Closed.

2. Normal Operation: When CO2 Level is between 700 PPM and 1000 PPM (Owner provided and adjustable setpoint).
   a. OA Damper Position: Modulate damper as follows:
      1) Minimum open position at 700 PPM or less.
      2) Maximum open position at 1000 PPM (OA not to exceed scheduled CFM).
   b. Initiate Alarm if CO2 levels exceed 1200 PPM
   c. Close OA Damper if OAT drops below 35F or rises above 105F (adj. Setpoints.), or if space humidity rises more than 10% above set point (adjustable).
   d. CO2 sensors: Shall be provided by equipment manufacturer.

J. Graphics Display: Indicate the following on display terminal for every unit:
1. System graphic.
2. System occupied/unoccupied mode.
3. System on-off indication.
4. Fan status.
5. Fan speed.
6. System Heating / Cooling mode indication.
7. System Dehumidification mode indication.

8. Cooling Stage 1 Compressor on-off indication.
9. Cooling Stage 2 Compressor on-off indication.
10. Compressor speed/staging.
11. Hot Gas Reheat Valve on-off indication.
12. Discharge air temperature indication.
13. Outside-air-temperature indication.
14. Space-temperature indication.
15. Space-temperature setpoint.
16. Space relative humidity indication.
17. Space relative humidity setpoint.
18. CO_2 level indication.
19. CO_2 level setpoint.
20. Outside-air-damper position.
21. Electric duct heater stage status.
22. Electric duct heater stage command.
23. Economizer mode status.
24. Additional graphics for space T sensors and bypass dampers. See drawings.

1.11 CONTROL SEQUENCES FOR DX RTUS WITH DOAS

A. Ensure that provided sequences are coordinated with those specified in Div. 23, Section 237413 Packaged, Outdoor, Central-Station Air-Handling Units. Since units are served with DOAS the units shall be configured as follows:
   1. No hot gas reheat coils and dehumidification modes
   2. No OA intake, RA dampers, and economizer modes.
   3. Pre-treated OA from DOAS. Provide CO2 based demand controlled ventilation (DCV).

B. Fan Control: **System** starts fan to run continuously during occupied periods. **System** cycles fan during unoccupied periods.
   1. Signal alarm if fan fails to start as commanded.
   2. Fan shall vary speed in coordination with compressor staging.

C. Unoccupied Mode Enable/Disable: During unoccupied hours, enable unit operation and control under the conditions listed below. Unit shall run for a minimum of 30 minutes or until space conditions are satisfied.

D. Start-Up Operation: In the order of priority, start-up operation shall be commanded as follows:
   1. System shall initiate unit and command to Cooling Mode if space temperature is above cooling setpoint.
   2. System shall initiate unit and command to Heating Mode, if space temperature is below heating setpoint.
   3. If temperature setpoint is satisfied at start-up, but humidity setpoint is not, System shall initiate alarm.

E. Cooling Mode:
   1. System cycles compressor stages to maintain space air temperature setpoint (74F, adj.).

F. Dehumidification Mode: NA

G. Heating Mode (Electric):

1. When space temperature drops below heating setpoint (69F, adj.), **system** enables one stage of heat.
2. If a stage is enabled and space temperature continues to remain below setpoint by 2°F for more than 5 minutes, system enables additional heat stage, similarly for additional stages.
3. System disables stages, one at a time, when temperature rises above setpoint by 2°F for more than 5 minutes. Coordinate number of stages with heater.

H. Ventilation (OA) Sequence:
1. Outside air is served via OA pretreatment unit.
2. Provide space CO2 sensors, and motorized OA dampers on OA duct connections for DCV. Provide controls sequences to modulate OA dampers to maintain CO2 setpoint.
3. When DOAS is in economizer mode, CO2 based DCV shall be overridden. OA dampers shall go to 100% (adj) open position.
4. Program two damper positions (adj.), for scheduled design OA CFM and minimum OA CFM, that is coordinated via TAB with the DOAS units.
5. Unoccupied Periods:
   a. OA Damper Position: Closed.
   b. Coordinate OAD damper schedule with DOAS on/off schedule to prevent OADs from closing if DOAS is ON.
6. Normal Operation: When CO2 Level is between 700 PPM and 1100 PPM (Owner provided and adjustable setpoint).
   a. OA Damper Position: Modulate damper as follows:
      1) Minimum open position at 700 PPM or less.
      2) Maximum open position at 1100 PPM (OA not to exceed scheduled CFM).
   b. Initiate Alarm if CO2 levels exceed 1200 PPM
   c. Close OA Damper if pre-treatment air T drops below 35F or rises above 105F (adj. Setpoints.), or if space humidity rises more than 10% above set point (adjustable).

I. Graphics Display: Indicate the following on display terminal for every unit:
1. System graphic.
2. System occupied/unoccupied mode.
3. System on-off indication.
4. Fan status.
5. Fan speed.
6. System Heating / Cooling mode indication.
7. Cooling Stage 1 Compressor on-off indication.
8. Cooling Stage 2 Compressor on-off indication.
9. Compressor speed/staging.
10. Discharge air temperature indication.
11. Pre-treated Outside-air-temperature (supply from DOAS) indication.
12. Space-temperature indication.
13. Space-temperature setpoint.
14. Space relative humidity, where indicated.
15. Electric duct heater stage status.
16. Electric duct heater stage command.
17. CO_2 setpoint and indication
18. OA damper command and indication

1.12 CONTROL SEQUENCES FOR DEDICATED OUTSIDE SYSTEMS (DOAS)

A. Control system shall be provided by unit manufacturer and shall be similar to those provided by Aaon units. Coordinate with Div. 23 Section for DOAS control.

B. In the main supply ducts from the DOAS, provide static pressure sensor to modulate DOAS fan speed.

C. BAS Interface between DOAS unitary controller and BAS controls shall have the following features:
   1. Off/Enable: Program Off/Enable times as per Owner's input. Each system will have a dedicated time schedule available for programming by user.
   2. Setpoint adjustment for unit discharge air temperature and cooling coil air temperature for dehumidification.

D. Start-Up Operation: In the order of priority, start-up operation shall be commanded as follows:
   1. By BAS:
      a. System shall initiate unit based on programmed off/enable time schedule. Preliminary recommended hours (8:30AM – 4:00PM, week days, adj).
      b. During start-up, unit will be enabled in the cooling mode if outside air temperature is 55 F (adjustable) or above. During normal cooling mode operation, DOAS will deliver (DAT 54.0F adj) downstream of main cooling coil.
      c. DOAS DAT setpoint programmable between 52F (adj) and 65F (adj). If majority of the units served by the DOAS are overcooling or in heating mode, gradually reset discharge air temperature higher. Return to normal operation when majority of the units are in cooling mode again. Provide additional hours of programming for fine tuning discharge air temperature reset operation.
      d. When OAT is less than 55F (adj.), and majority of the units are in heating mode, gradually raise the discharge air temperature to 68F (adj). If hot gas reheat not capable of warming discharge air to setpoint, modulate electric heat to do so.
   2. By DOAS unitary controller:
      a. Cycle compressor stages, hot gas reheat valve, electric heater to maintain discharge air setpoints that are communicated via BAS.
         1) With modulating hot gas reheat, unit shall modulate cooling and hot-gas reheat as efficiently as possible, to meet outside air humidity loads and prevent supply air temperature swings and overcooling of the space.
         2) Unit shall modulate heating to based on supply air temperature.
         3) When OAT and OARH allow, OAU shall operate in economizer mode.
         4) Modulate DOAS fan speed to maintain static pressure setpoint (adj.).
         5) When unit is in economizer mode, CO2 based DCV shall be overridden. OA dampers shall go to 100% (adj) open position.

E. Alarms displayed by BAS:
   1. Discrepancy between actual and commanded state of operation.
   2. Discharge air temperature deviates from setpoint by 3˚F for more than 5 minutes.
   3. Duct static pressure deviates from setpoint for more than 5 minutes.

F. Operator Station Display: Indicate the following on operator workstation display terminal (if applicable) per each unit:
   1. Outside-air-temperature indication.
   2. Outside-air-RH indication.

3. System on-off indication.
4. System occupied/unoccupied mode.
5. System Heating / Cooling mode indication.
6. Fan status.
7. Fan speed command and indication
8. Duct static pressure setpoint and indication
9. Discharge air temperature setpoint and indication.
10. Discharge air temperature dewpoint setpoint and indication.
11. Coil air temperature dehumidification setpoint and indication.
12. Compressor stages.
13. Digital scroll compressor capacity signal
14. Modulating hot gas reheat valve capacity signal.
15. Heater stages.
16. Time schedule for every piece of equipment.

G. Safeties:
1. Freeze-stat safety.
2. High temperature safety.
3. High duct static pressure safety.

1.13 FCU SCHEDULED CONTROL SEQUENCES (DX FCU and ACCU)

A. Applicable to FCUs and associated ACCUs serving MDF, IDF and Elevator rooms.

B. Unit Default Mode:
1. Acts as independent DX system. Upon start-up, enable unit in cooling mode.
2. If space temperature is rises above cooling setpoint (adjustable), enable unit on.

C. Cooling Sequences
1. Unit Start/Stop: Enable unit according to Scheduled Control Sequences.
2. Monitor unit status and space temperature.
3. Heating and Ventilation Modes: Not applicable.

D. Operator Workstation: Display the following data:
1. System graphic.
2. Unit commanded state.
3. Unit status (fan on/off)
4. Unit Status (ACCU on/off)
5. Space Temperature.

1.14 BUILDING EXHAUST FAN SCHEDULED CONTROL SEQUENCES

A. Sequence:
1. Enable/disable EFs according to occupancy schedule. Occupancy times will be initially set-up according to the Automatic Time Schedule for each fan and shall be completely operator adjustable for fans individually.
2. Exhaust fans shall have a dedicated time schedule (that is independent of AHU time schedule). Coordinate time schedules such that exhaust fans are operational only when

associated outside air dampers are open. Under no circumstances should exhaust fans operate when outside air dampers are closed.

B. Manual Override: Control may be manually overridden at the controller and at the COS. Control will remain in "Override" position for a pre-programmed time period (1 hour, adj).

C. All other exhaust fans: Fans operate continuously via time schedules during occupied mode.
1. Restroom fans operate continuously during occupied mode.
2. Janitor room fan operates via light switch.
3. General purpose exhaust fans, etc.

D. Operator Workstation: Display the following data:
1. System graphic.
2. System occupied/unoccupied mode.
3. Fan on-off command.
4. Fan status.
5. Associated AHU status.

1.15 ELECTRIC METER MONITORING

Applies to Main Distribution Panels for facility. Coordinate with Electrical.

A. All metering devices, PTs, CTs, miscellaneous hardware and software shall be provided by DDC Contractor. Meter shall be Shark50B-X Revenue Grade Shark50B BACnet/MSTP Communicating Multifunction Power Meter, or equal.

B. Pulsed output relays for Kvarh, Kwh, and time shall be coordinated at electric meters, distribution panels, and switchboards. Coordinate with electric provider for information on pulsed outputs. Calculate all parameters indicated in Operator Station Display paragraph below which are not directly measured, based upon measured inputs from these three pulsed output relays. Coordinate installation and control with Div. 16.

C. Coordinate with electric provider to determine billing cycle / meter read dates, and translation values for pulsed outputs.

D. Points List

Point Type	Description
AI (See Note below **)	kVA
AI (See Note below **)	kWh
AI (See Note below **)	PF

** **Provide all necessary hardware such as CTs, multi-meter devices, etc.**

E. Operator Station Display: Indicate the following on operator workstation display terminal:
1. kWh since start of monthly billing cycle.
2. kWh, year to date.
3. Peak KVA demand, year to date.
4. Current KVA demand.
5. Current kW demand.
6. Current Power Factor.

7. Peak KVA demand in current monthly billing cycle.

F. Trend and store the following measured and calculated parameters on a 15 minute basis:
1. kWh.
2. KVA demand.
3. kW demand.
4. Power Factor.

1.16 OTHER SEQUENCES

A. Operator Overrides: System shall allow operator to enable / disable unit and / or control / adjust all setpoints from COS.

B. Alarms: System shall issue alarm at COS upon failure of fan or failure to achieve setpoint within specified time (15 min. adj.)

C. Graphics pages must have units listed beside parameter values (e.g. ˚F, ppm, % Open, psi, etc.)

D. When parameters are in manual or test modes, graphics shall indicate that they are in test mode.

E. Provide up to 8 hours of programming to account for additional control sequences and fine-tuning above sequences, during the course of the project.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230993

SECTION 232300 - REFRIGERANT 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. Refrigerant pipes and fittings.
2. Refrigerant piping valves and specialties.
3. Refrigerants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty.

1. Include pressure drop, based on manufacturer's test data, for the following:

a. Thermostatic expansion valves.
b. Solenoid valves.
c. Hot-gas bypass valves.
d. Filter dryers.
e. Strainers.
f. Pressure-regulating valves.

B. Shop Drawings:

1. Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes; flow capacities; valve arrangements and locations; slopes of horizontal runs; oil traps; double risers; wall and floor penetrations; and equipment connection details.
2. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
3. Show interface and spatial relationships between piping and equipment.
4. Shop Drawing Scale: 1/4 inch equals 1 foot.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to 2010 ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.7 PRODUCT STORAGE AND HANDLING

A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-134a:

1. Suction Lines for Air-Conditioning Applications: 115 psig.
2. Suction Lines for Heat-Pump Applications: 225 psig.
3. Hot-Gas and Liquid Lines: 225 psig.

B. Line Test Pressure for Refrigerant R-407C:

1. Suction Lines for Air-Conditioning Applications: 230 psig.
2. Suction Lines for Heat-Pump Applications: 380 psig.
3. Hot-Gas and Liquid Lines: 380 psig.

C. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig.
2. Suction Lines for Heat-Pump Applications: 535 psig.
3. Hot-Gas and Liquid Lines: 535 psig.

2.2 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type L, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Brazing Filler Metals: AWS A5.8/A5.8M.

E. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
4. Working Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.3 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:
1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

B. Packed-Angle Valves:
1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

C. Check Valves:
1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

D. Service Valves:
1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.

3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

E. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).
1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.

F. Safety Relief Valves: Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

G. Thermostatic Expansion Valves: Comply with AHRI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F.
6. Reverse-flow option (for heat-pump applications).
7. End Connections: Socket, flare, or threaded union.

H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
5. Seat: Polytetrafluoroethylene.
6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter and 24-V ac coil.
7. End Connections: Socket.
8. Throttling Range: Maximum 5 psig.
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 240 deg F.

I. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.

5. Maximum Operating Temperature: 275 deg F.

J. Moisture/Liquid Indicators:
1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in parts per million (ppm).
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

K. Permanent Filter Dryers: Comply with AHRI 730.
1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina, charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

L. Receivers: Comply with AHRI 495.

1. Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
2. Comply with UL 207; listed and labeled by an NRTL.
3. Body: Welded steel with corrosion-resistant coating.
4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
5. End Connections: Socket or threaded.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

M. Liquid Accumulators: Comply with AHRI 495.
1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

2.4 REFRIGERANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Arkema Inc.
2. DuPont Fluorochemicals Div.
3. Genetron Refrigerants; Honeywell International Inc.
4. Mexichem Fluor Inc.

B. ASHRAE 34, R-134a: Tetrafluoroethane.

C. ASHRAE 34, R-407C: Difluoromethane/Pentafluoroethane/1,1,1,2-Tetrafluoroethane.

D. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

2.5 REFRIGERANT PIPING SUPPORT EXTERIOR TO BUILDING

A. Exterior: Pre-manufactured strut supports; 3/8” stainless steel threaded rods holding 7” long aluminum cross-strut, stainless steel bolts, 3” to 6” adjustable height, molded 33% fiberglass reinforced nylon support base; UV stabilized. MAPA Products, type MS-2 or MS-3.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Suction Lines NPS 2 to NPS 4 for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

D. Safety-Relief-Valve Discharge Piping: Schedule 40, black-steel and wrought-steel fittings with welded joints.

E. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

F. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

E. Install a full-size, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

G. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

H. Install safety relief valves where required by 2010 ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Hot-gas bypass valves.
4. Compressor.

K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

L. Install receivers sized to accommodate pump-down charge.

M. Install flexible connectors at compressors.

3.3 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 Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

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 adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC" for solenoid valve controllers, control wiring, and sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in protective conduit where installed belowground.

N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

O. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Q. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:

1. Shot blast the interior of piping.
2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.

R. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

S. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 PIPE 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 pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

F. Threaded Joints: Thread steel 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 to 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.

G. Welded Joints: Construct joints according to AWS D10.12M/D10.12.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 HANGERS AND SUPPORTS

A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:

1. NPS 1/2: Maximum span, 60 inches; minimum rod, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod, 3/8 inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod, 3/8 inch.
6. NPS 2: Maximum span, 96 inches; minimum rod, 3/8 inch.
7. NPS 2-1/2: Maximum span, 108 inches; minimum rod, 3/8 inch.
8. NPS 3: Maximum span, 10 feet; minimum rod, 3/8 inch.
9. NPS 4: Maximum span, 12 feet; minimum rod, 1/2 inch.

D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.

    a. Fill system with nitrogen to the required test pressure.
    b. System shall maintain test pressure at the manifold gage throughout duration of test.
    c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

B. Prepare test and inspection reports.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 233113 - 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, spiral-seam, round ducts and fittings.
3. Double-wall, round and flat-oval spiral-seam ducts and formed fittings.
4. Sheet metal materials.
5. Duct liner.
6. Sealants and gaskets.
7. Hangers and supports.
8. Kitchen hood exhaust grease duct, dishwasher hood duct.

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.
3. Section 233813 “Commercial Kitchen Hoods”.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: 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. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

E. Kitchen exhaust duct shall be pre-fabricated, double wall grease duct according to this specification.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
   1. Liners and adhesives.
   2. Sealants and gaskets.
   3. Fire-Stopping Materials.

B. Shop Drawings:
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   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.

C. Delegated-Design Submittal:
   1. Sheet metal thicknesses.
   2. Joint and seam construction and sealing.
   3. Reinforcement details and spacing.
   4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: 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. Duct installation in congested spaces, 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.
f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. 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 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 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 SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to 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 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 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 SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. Round, Spiral Lock-Seam Ducts.

B. General Fabrication Requirements: Comply with 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.
   1. Manufacturers:
      a. Lindab Inc.
      b. McGill AirFlow LLC.
      c. SEMCO Incorporated.
      d. Sheet Metal Connectors, Inc.
      e. Spiral Manufacturing Co., Inc.

C. 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).

D. Duct Joints:
   1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
   2. Ducts 21 to 72 Inchesin Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
   3. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
      a. Manufacturers:
         1) Ductmate Industries, Inc.
         2) Lindab Inc.

E. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

F. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

G. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Unless elbow construction type is indicated, fabricate elbows as follows:
   1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
   2. Round Mitered Elbows with Aerofoil Vanes: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:
      a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
      b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.

   3. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
   4. Round Elbows 8 Inchesand Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate

nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

5. Round Elbows 9 through 14 Inchesin Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
6. Round Elbows Larger than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
7. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.
8. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
9. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.

2.3 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Lindab Inc.
2. McGill AirFlow LLC.
3. SEMCO Incorporated.

B. Ducts: Prefabricated double-wall (insulated) ducts with an outer shell and an inner duct. Dimensions indicated are for inner ducts.

C. 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) of the inner duct.

D. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
1. Transverse Joints: Select joint types and fabricate according to 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 SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

2. Longitudinal Seams: Select seam types and fabricate according to 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 SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3. Tees and Laterals: Select types and fabricate according to 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 SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Inner Duct: Minimum 0.028-inch solid sheet steel.

F. Fittings: Fabricate double-wall (insulated) fittings with an outer shell and an inner duct.
1. Solid Inner Ducts: Use the following sheet metal thicknesses:
   a. Ducts 3 to 34 Inches in Diameter: 0.028 inch.
   b. Ducts 35 to 58 Inches in Diameter: 0.034 inch.
   c. Ducts 60 to 88 Inches in Diameter: 0.040 inch.

G. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Maximum Thermal Conductivity: 0.26 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Terminate insulation where double-wall duct connects to single-wall externally insulated duct, and reduce outer shell diameter to inner duct diameter.
4. Coat insulation with antimicrobial coating.
5. Cover insulation with polyester film complying with UL 181, Class 1.
6. Supply and Make-Up Air Ducts: **2 inches** thick.
7. **Painted for indoor application.** Coordinate final finish with architect.

2.4 SHEET METAL MATERIALS

A. General Material Requirements: 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.

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. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

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.

2.5 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Manufacturers:
      a. Owens Corning's Aeroflex Plus Duct Liner or Equal.

   2. Materials: ASTM C 1071; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers.
      a. Maximum Thermal Conductivity:
      b. Thickness: 1 inch for sound attenuation, and R8 for thermal insulation.
      c. Thermal Conductivity (k-Value): 0.26 at 75 deg Fmean temperature.
      d. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E84.
      e. Water-Based Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B. 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).
      f. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
         1) Tensile Strength: Indefinitely sustain a 50-lb-tensile, dead-load test perpendicular to duct wall.
         2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
         3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.

   3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

2.6 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 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-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.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. 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."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. 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.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.8 FIRE-STOPPING

A. Fire-Resistant Sealant: Provide two-part, foamed-in-place, fire-stopping silicone sealant, one-part elastomeric sealant, formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

B. Products: Subject to compliance with requirements, products that may be incorporated in the Work are limited to, the following:
1. "Dow Corning Fire Stop Foam"; Dow Corning Corp.
2. "Dow Corning Fire Stop Sealant"; Dow Corning Corp.
3. "3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.

C. Seams and laps arranged on top of duct.

2.9 INSULATED, PRE-FABRICATED GREASE DUCT (KITCHEN HOOD EXHAUST DUCT)

A. See Section 233533 Listed Kitchen Ventilation System Exhaust Ducts.

2.9 STAINLESS STEEL DUCT (DISHWASHER EXHAUST DUCT)

A. Construction, installation and testing shall be per applicable codes.

B. Dishwasher Hood Exhaust Ducts:
1. Type 304, stainless steel with finish to match kitchen equipment and range hood.
2. Rated for transportation of steam and heat laden vapors from commercial dishwashing operation.
3. Weld and flange seams and joints. Seams and laps arranged on top of duct.

4. Include all supports, roof penetrations, fan adapters, square-to-round transitions, hood connectors, drain fittings and expansion joints required to install duct.
5. Roof penetration pieces shall be UL listed products. Where roof is pitched (up to 12:12), roof penetration pieces shall be of the pitched type so that it is not necessary to provide a horizontal roof curb.
6. Comply with NFPA 96.

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 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 SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DISHWASHER EXHAUST DUCTS, SPECIAL INSTALLATION REQUIREMENTS

A. Install ducts to allow for thermal expansion through temperature range.

B. Install ducts without dips or traps that may collect residues unless traps have continuous or automatic residue removal.

C. Install access openings at each change in direction and at intervals defined by NFPA 96; locate on sides of duct a minimum of 1-1/2 inches from bottom; and fit with air-tight covers of same material as duct.

3.4 APPLICATION OF LINER IN RECTANGULAR DUCTS

A. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

B. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

C. Butt transverse joints without gaps and coat joint with adhesive.

D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

E. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.

F. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.

G. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

H. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   1. Fan discharges.
   2. Intervals of lined duct preceding unlined duct.
   3. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.

I. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

3.5 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", and as defined below.
   1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   2. All Ducts U.N.O: Seal Class A.
   3. Unconditioned Space, Return-Air Ducts: Seal Class B.
   4. Conditioned Space, Return-Air Ducts: Seal Class C.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with 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. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Spacing: 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," 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.

3.7 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 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 Division 9 Sections.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:
   1. **Comply with requirements for Leakage Class A for sealing all ducts.** Refer to SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
   2. Test the following systems:
      a. Supply, Return, Exhaust, Outdoor Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
      b. Engineer will randomly designate two supply duct systems for testing in accordance with Section 4 of SMACNA HVAC Air Duct Leakage Test Manual, current edition. If leakage test results exceed SMACNA allowable leakage rates, then additional two systems shall be tested. Supply duct test section shall include main trunk line from the mechanical room to the farthest VAV box. For systems without VAV boxes, main trunk shall be determined on site

   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 seven days' advance notice for testing.

C. Duct System Cleanliness Tests:
   1. Visually inspect duct system to ensure that no visible contaminants are present.
   2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
      a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.10 DUCT CLEANING

A. Clean new and existing 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. Particulate Collection and Odor Control:
   1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
   2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. 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, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, 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.

E. 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 according to NADCA 1992. 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.

3.11 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.12 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

A. Supply Ducts:
1. Ducts Connected to Fan Coil Units, and Terminal Units:
   a. Pressure Class: Positive 2-inch wg.
   b. Minimum SMACNA Seal Class: A
2. Ducts Connected to Constant-Volume Air-Handling Units, including DOAS
   a. Pressure Class: Positive 3-inch wg
   b. Minimum SMACNA Seal Class: A
3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
   a. Pressure Class: Positive 4-inch wg.
   b. Minimum SMACNA Seal Class: A

B. Return Ducts:
1. Ducts Connected to Fan Coil Units, and Terminal Units
   a. Pressure Class: Positive or negative 2-inch wg
   b. Minimum SMACNA Seal Class: B.
2. Ducts Connected to Air-Handling Units
   a. Pressure Class: Positive or negative 3-inch wg
   b. Minimum SMACNA Seal Class: B

C. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
   a. Pressure Class: Negative 2-inch wg
   b. Minimum SMACNA Seal Class: A

2. Ducts Connected to Dishwasher Hoods:
   a. Type 304, stainless-steel sheet.
   b. Welded seams and flanged joints with watertight EPDM gaskets.
   c. Pressure Class: Positive or negative 2-inch wg
   d. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
   e. SMACNA Leakage Class: 3.

3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.

a. Duct shall be factory fabricated.
b. Exposed to View: Type 304, stainless-steel sheet
c. Concealed: Type 304, stainless-steel sheet, No. 2D finish
d. Welded seams and joints.
e. Pressure Class: Positive or negative 3-inch wg
f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
g. SMACNA Leakage Class: 3.

D. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
1. Ducts Connected to AHUs, Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units
a. Pressure Class: Positive or negative 2-inch wg
b. Minimum SMACNA Seal Class: A

E. Double-Wall Duct Interstitial Insulation:
1. Supply Air Ducts: 2 inches thick, unless noted otherwise on drawings.

F. Elbow Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
a. Double Skin vaned elbows. See drawings.
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with 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) Radius-to Diameter Ratio: 1.5.
b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

G. Branch Configuration:
1. Rectangular Duct: Comply with 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: Spin in.
2. Round and Flat Oval: Comply with 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 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - 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. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Fire dampers.
6. Flange connectors.
7. Turning vanes.
8. Remote damper operators.
9. Duct-mounted access doors.
10. Flexible connectors.
11. Flexible ducts.
12. 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-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to 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.

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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

1.7 QUALITY ASSURANCE

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 AMCA 500-D testing for damper rating.

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/A 653M.
   1. Galvanized Coating Designation: G90.
   2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304.

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 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Pottorff.
4. Ruskin Company.

B. Description: Gravity balanced. Blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner, steel ball bearings, and axles.

C. Frame: Hat-shaped, 0.05-inch-thick, galvanized sheet steel, with welded corners and mounting flange.

D. Blades: Multiple single-piece blades, 0.050-inch-thick aluminum sheet with sealed edges.

E. Blade Action: Parallel.

F. Blade Seals: Neoprene, mechanically locked.

G. Blade Axles:
1. Material: Galvanized steel.

H. Tie Bars and Brackets: Galvanized steel.

I. Return Spring: Adjustable tension.

J. Accessories:
1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators, where noted.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.
    a. Sleeve Thickness: 20 gage minimum.
    b. Sleeve Length: 6 inches minimum.
6. Screen Mounting: Rear mounted.
7. Screen Material: Stainless steel.
8. Screen Type: Bird.
9. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Flexmaster U.S.A., Inc.
    b. McGill AirFlow LLC.
    c. Nailor Industries Inc.
    d. Pottorff.
    e. Ruskin Company.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:

    a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
    b. Mitered and welded 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. Stiffen damper blades for stability.
    d. Galvanized-steel, 0.064 inch thick.

6. Blade Axles: Galvanized steel.
7. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. McGill AirFlow LLC.
    b. Nailor Industries Inc.
    c. Pottorff.
    d. Ruskin Company.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with 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. Stiffen damper blades for stability.
    d. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.

e. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.

6. Blade Axles: Galvanized steel.
7. Tie Bars and Brackets: Aluminum.

C. Low-Leakage, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Pottorff.
b. Ruskin Company.

2. Comply with AMCA 500-D testing for damper rating.
3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
4. Suitable for horizontal or vertical applications.
5. Frames:

a. Hat shaped.
b. 0.094-inch-thick, galvanized sheet steel.
c. Mitered and welded corners.
d. Flanges for attaching to walls and flangeless frames for installing in ducts.

6. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Galvanized, roll-formed steel, 0.064 inch thick.

7. Blade Axles: Galvanized steel.
8. Blade Seals: Neoprene.
9. Tie Bars and Brackets: Galvanized steel.
10. Accessories:

a. Include locking device to hold single-blade dampers in a fixed position without vibration.

D. Low-Leakage, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Pottorff.
b. Ruskin Company.

2. Comply with AMCA 500-D testing for damper rating.
3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
4. Suitable for horizontal or vertical applications.

5. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
6. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
    d. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.

7. Blade Axles: Galvanized steel.
8. Blade Seals: Neoprene.
9. Tie Bars and Brackets: Aluminum.
10. Accessories:

    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

E. Jackshaft:
1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.5 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Pottorff.
3. Ruskin Company.
4. Young Regulator Company.

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:
1. Hat shaped.
2. 0.094-inch-thick, galvanized sheet steel.
3. Mitered and welded corners.

D. Blades:
1. Multiple blade with maximum blade width of 6 inches.

2. Opposed-blade design.
3. Galvanized-steel.
4. 0.064 inch thick single skin.
5. Blade Edging: Closed-cell neoprene.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: 1/2-inch-diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:
1. Molded synthetic.
2. 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.
3. Thrust bearings at each end of every blade.

2.6 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Pottorff.
3. Ruskin Company.

B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.138 inch 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.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.7 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Nexus PDQ.
3. Ward Industries, Inc.

B. Description: Factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.8 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. METALAIRE, Inc.
3. SEMCO Incorporated.
4. Ward Industries, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

D. Vane Construction: Double wall.

2.9 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Pottorff.
2. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass.

D. Cable: Stainless steel.

E. Wall-Box Cover-Plate Material: Stainless steel.

2.10 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flexmaster U.S.A., Inc.
2. Greenheck Fan Corporation.
3. Pottorff.

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.

2.11 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ward Industries, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

E. 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.

F. 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.

G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
1. Minimum Weight: 16 oz./sq. yd..
2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
1. Minimum Weight: 14 oz./sq. yd..
2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

2.12 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Flexmaster U.S.A., Inc.
2. Thermaflex

A. Where acoustical flexible duct is shown on drawings, provide Flexmaster Type 8M (or Thermaflex M-KE) UL 181 Class I Air Duct or equal.

B. The duct shall be constructed of a CPE fabric supported by helical wound galvanized steel. The fabric shall be mechanically locked to the steel helix without the use of adhesives or chemicals.

C. The internal working pressure rating shall be at least 6” w.g. positive and 4” w.g. negative through 16” diameter, and 1” w.g. negative for 18” and 20” diameters, with a bursting pressure of at least 2 ½ time the working pressure.

D. The duct shall be rated for a velocity of at lease 4000 feet per minute.

E. The duct must be suitable for continuous operation at a temperature range of -20° F to +250° F.

F. Factory insulate the flexible duct with fiberglass insulation. The R-value shall be at least 8 at a mean temperature of 75° F.

G. Cover the insulation with a fire retardant metalized vapor barrier jacket reinforced with crosshatched scrim having a permeance of not greater than 0.05 perms when tested in accordance with ASTM E96, Procedure.

H. Sound attenuation Properties: 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:

Octave Band	**2**	**3**	**4**	**5**	**6**	**7**
Hz.	125	250	500	1000	2000	4000
6” diameter	7	31	40	38	40	27
8” diameter	13	29	36	35	38	22
12” diameter	21	28	29	33	26	12

I. Flexible Duct Connectors:
   1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

2.13 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, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers (control dampers for fans 2,000CFM and larger) 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.
   2. Install aluminum volume dampers in aluminum 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 and smoke 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 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. At each change in direction and at maximum 50-foot spacing.
8. Upstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.
11. 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, and for fan powered boxes with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

O. Connect flexible ducts to metal ducts with stainless steel draw bands.

P. 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, smoke, and combination fire and smoke 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.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233423 - 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. Ceiling-mounted ventilators.
   2. Centrifugal roof ventilators.
   3. Up-blast centrifugal roof ventilator and make up supply air fan (kitchen ventilation system).
   4. In-line fans.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on sea level.

B. Operating Limits: Classify according to AMCA 99.

C. Delegated Design: Design roof curbs to comply with **wind** performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

D. Wind-Restraint Performance rated for basic Wind Speed: Rated for project location.

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. Fan speed controllers.
   7. Roof curbs.

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.

C. Delegated-Design Submittal: For unit hangars and supports 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. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
   2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
   3. Wind Restraints and Certification.

D. Manufacturer Wind Loading Qualification Certification: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article, Division 7 and in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force 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.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans 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. 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.
   5. Roof framing and support members relative to duct penetrations.

B. Certified Compliance Statement and shop drawings from a licensed PE for IBC and TDI.
   1. Sealed shop drawings showing installation instructions and attachment of equipment to curb, and curb to structure. Include quantity and type of restraining brackets/clips, screws, spacing, etc.
   2. As a separate attachment provide sealed IBC and TDI compliant calculations for curbs and attachment.

C. 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 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. Belts: One set for each belt-driven unit.

1.8 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.

D. International Building Code and TDI Compliance: Licensed Professional Engineer shall certify that the listed items are designed for and will withstand wind speed for the location of the project, per the relevant edition of International Building Code, ASCE Std 7, Texas Department of Insurance requirements.
   1. Equipment curb/attachment for exterior and roof mounted equipment such as fans.
   2. Attachment of equipment to curb/pad.
   3. Attachment of curb/pad to building structure.

1.9 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

1.10 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: A written warranty, executed by Contractor and signed by manufacturer, agreeing to replace components that fail in materials and workmanship within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.
   1. Warranty Period: One (1) year parts and labor for fan and motor, including all components, from date of Substantial Completion.

1.11 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. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. HVAC Power Ventilators: ubject to compliance with requirements, provide products by one of the following:
   1. Loren Cook Company.
   2. Greenheck Fan Corp.
   3. New York Blower Company (The).
   4. Penn Ventilation.

2.2 CEILING-MOUNTED VENTILATORS

A. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.

B. Housing: Steel, lined with acoustical insulation.

C. Fan Wheel: Centrifugal forward curved type, injection molded of polypropylene resin for smaller fans, galvanized steel for larger fans.

D. Grille: Manufacturer's standard **Aluminum**, louvered grille with flange on intake and thumbscrew attachment to fan housing.

E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

F. Accessories:
   1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
   2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
   3. Factory mounted disconnect
   4. Stainless steel insect screen
   5. Isolation: Rubber-in-shear vibration isolators.
   6. Aluminum backdraft damper
   7. Vibration isolator kit
   8. Time-Delay Switch: See schedules for switch coordination.
   9. See schedules for other options.

2.3 IN-LINE CENTRIFUGAL AND MIXED FLOW INLINE FANS

A. Description: In-line, centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Driven Units: Motor encased in housing outside of airstream, factory wired to disconnect switch located on outside of fan housing.

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

F. Accessories:
1. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
2. Companion Flanges: For inlet and outlet duct connections.
3. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
5. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit. **See schedules.**
6. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
7. See schedules for other options.

2.4 IN-LINE CENTRIFUGAL FANS

A. Description: In-line mounted, centrifugal fans that are UL 705 listed, AMCA certified.

B. Housing: 20 gauge galvanized steel and acoustically insulated. Blower and motor assembly mounted on 14 ga. reinforced channel, resiliently mounted fan. Inlet and outlet duct flanges, reinforced aluminum dampers with continuous aluminum hinge rods and brass bushings.

C. Wheels: twin DWDI centrifugal forward curved type, galvanized steel, balanced in accordance with AMCA Std 204-96 Balance Quality and Vibration Levels for Fans.

D. Motor: Totally enclosed with permanently lubricated bearing and built-in thermal overload protection.

E. Accessories:
1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired.
2. For two speed exhaust fans in science laboratories, do NOT include integral disconnect switch. This will be provided by electrical. See schedules.
3. See schedules for other options.

2.5 SPARK RESISTANT FANS

A. For fume hood application, provide spark resistant fan per schedules.

2.6 CENTRIFUGAL ROOF VENTILATORS

A. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

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. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
   1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
   2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
   3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
   4. Fan and motor isolated from exhaust airstream.

E. Accessories:
   1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
   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, stainless steel.
   4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
   5. Motorized Dampers for airflow 2000CFM and larger: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
   6. Explosion proof motors and spark resistant fans where indicated.

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.

2.7 COMMERCIAL KITCHEN VENTILATION SYSTEMS:

A. Provide a complete packaged ventilation system with all necessary components to include: up-blast exhaust fan, make-up air supply fan, and master control panel with disconnect switch.

B. See below.

2.8 UP-BLAST CENTRIFUGAL EXHAUST VENTILATOR

A. Construction: Bolted and welded construction utilizing corrosion resistant fasteners. Spun aluminum structural components constructed of minimum 16-gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have a one piece inlet spinning and continuously welded curb cap corners for maximum leak protection. The wind-band shall have a rolled bead for added strength. A two piece top cap shall have quick release latches to provide access into the motor compartment. An external wiring compartment with integral conduit chase shall be provided into the motor compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a minimum 14-gauge steel power assembly. These Components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. A 1-inch thick, three-pound density foil backed heat shield shall be utilized to protect the motor and drive components from excessive heat. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit-tested packaging.

B. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA standard 204-96, balance quality and vibration levels for fans.

C. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure. Provide pre-wired disconnect switch.

D. Bearings: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy-duty regreasable ball type in a cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

E. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drive shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

F. Provide Cook Grease Terminator, vented curb extension, and hinged base per NFPA-96.

G. Roof Curbs: Mechanical contractor to coordinate dimensions and location with roofing contractor and Div. 7 specifications for tie-downs.

H. Accessories: See schedules.

2.9 ROOF MOUNTED, FILTERED KITCHEN AIR SUPPLY FAN

A. Description: Side intake, roof mounted, belt driven, centrifugal filtered supply air fan, mounted on roof curb, with extended intake vent, motor and disconnect switch, drive assembly, mounting kits, and accessories.

B. Certifications: Manufactured at an ISO 9001 certified facility, listed by Underwriters Laboratories (UL 705). Fan shall bear the AMCA certified ratings seal for sound and air performance.

C. Construction: Bolted construction utilizing corrosion resistant fasteners. Housing minimum 18 gauge galvanized steel bolted to a minimum 16 gauge steel fan base with prepunched mounting

holes. Unit shall be provided with an insulated top cover and 1" washable permanent aluminum filter. Internal blower and motor assembly shall be mounted on rubber vibration isolators. Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM, static pressure, and maximum fan RPM. Unit shipped in ISTA certified transit tested packaging.

D. Fan Wheel: Wheel shall be DWDI, centrifugal forward curved type, constructed of painted steel. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.

E. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure. Rated for VFD duty.

F. Bearings: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a pillow block cast iron housing selected for a minimumL50 life in excess of 200,000 hours at maximum cataloged operating speed.

G. Drive: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

H. Accessories:
1. Motorized backdraft damper.
2. Permanent Filters: One-inch, washable aluminum type, easily removable for cleaning.
3. Dedicated roof curb for exhaust and supply air fans, as indicated.
4. Ecoat or Lorenized coating on all exposed vent hood and fan cabinets.
5. See schedules.

2.10 ROOF MOUNTED EQUIPMENT

A. Wind Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site.

B. Ecoat or Lorenized coating on all exposed fans, vent hoods and fan cabinets

2.11 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.

2.12 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. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 7 Section "Roof Accessories" for installation of roof curbs.

C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

D. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548.13 "Vibration Controls for HVAC."

E. Install units with clearances for service and maintenance.

F. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

G. Coordinate installation of kitchen ventilation fan systems with commercial kitchen ventilation hoods and duct systems. Install in accordance with manufacturer’s instructions.
   1. Comply with all codes regarding the type of insulation required between the ventilation systems, wall and/or ceiling combustible material.
   2. Kitchen hood shall be hung level and lined up with roof exhaust openings.

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. 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 belt tension.
   6. Adjust damper linkages for proper damper operation.
   7. Verify lubrication for bearings and other moving parts.
   8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
   9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
   10. Shut unit down and reconnect automatic temperature-control operators.
   11. Remove and replace malfunctioning units and retest as specified above.

B. Starting Procedures:
   1. Energize motor and adjust fan to indicated rpm.
   2. Measure and record motor voltage and amperage.

C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain power ventilators.
   1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
   2. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
   3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 233423

SECTION 233533 - LISTED KITCHEN VENTILATION SYSTEM EXHAUST 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. Listed grease ducts.
2. Access doors.

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 listed grease ducts.

B. Shop Drawings: For listed grease ducts.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of hangers and seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in listed grease ducts and field-fabricated grease ducts.

SECTION 233533 - LISTED KITCHEN VENTILATION SYSTEM EXHAUST DUCTS

PART 2 - PRODUCTS

2.1 LISTED GREASE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Metal-Fab, Inc.
2. Selkirk Corporation.

B. Description: Factory-fabricated, -listed, and -labeled, double-wall ducts tested according to UL 1978 and rated for 500 deg F continuously, or 2000 deg F for 30 minutes; with positive or negative duct pressure and complying with NFPA 211.
   1. For use with Type I kitchen hoods, as described in NFPA-96, for the transportation of air and grease-laden vapors from commercial cooking operations.

C. Construction: Inner shell and outer jacket separated by at least a 1-inch annular space filled with high-temperature, ceramic-fiber insulation.

   1. Inner Shell: ASTM A 666, Type 304 stainless steel.
      a. 0.035” thick for diameters 6” through 36”
      b. 0.048” thick for diameters 38” through 48”

   2. Outer Jacket: Aluminized steel where concealed. Stainless steel where exposed.
      a. 0.024” thick aluminized steel for sizes 6” through 24”
      b. 0.034” thick for sizes 26” through 48”

   3. Inner and outer walls connected by means of spacer clips, which maintain the concentricity of the annular space and allow unobstructed differential thermal expansion of the inner and outer walls.

D. Gaskets and Flanges: Ensure that gaskets and sealing materials are rated at 1500 deg F minimum. All inner pipe joints shall be held together by means of formed Vee bands and sealed with P080 Grease Duct Sealant.

E. Hood Connectors: Constructed from same material as grease duct with internal or external continuously welded or brazed joints.

F. Accessories: Tees, elbows, increasers, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly. Include unique components required to comply with NFPA 96 including cleanouts, transitions, adapters, and drain fittings.
   1. Include all supports, roof penetrations, fan adapters, square-to-round transitions, hood connectors, drain fittings and expansion joints required to install insulated grease duct.
   2. Roof penetration pieces shall be UL listed products of the grease duct manufacturer. Where roof is pitched (up to 12:12), roof penetration pieces shall be of the pitched type so that it is not necessary to provide a horizontal roof curb.

G. Grease Duct Supports: Construct duct bracing and supports from non-combustible material.

1. Design bracing and supports to carry static and seismic loads within stress limitations of the International Building Code.
2. Ensure that bolts, screws, rivets and other mechanical fasteners do not penetrate duct walls.

H. Comply with
1. ASTM E 2336: Duct wall assembly tested and listed to 2 inches clearance to combustibles for 6 inch diameter, 3 inches clearance to combustibles for 8 to 18 inch diameters, and 4 inches clearance to combustibles for 20 to 24 inch diameters.
2. ASTM E119 Fire Engulfment Test, ASTM E814 3-hour Fire Stop Test: Grease duct shall conform to requirements.
3. Listed by the following agencies with the associated listed reports: UL 1978 (File MH8251) - Grease Ducts for Restaurant Cooking Appliances.

I. Factory Tests: Test and inspect fire resistance of grease duct system according to ASTM E 2336 in presence of Owner.

1. Allow consultant two days' minimum notification before test is performed.

2.2 ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M.
2. Acudor Products, Inc.
3. Ductmate Industries, Inc.

B. Description: Factory-fabricated, -listed, and -labeled, double-wall maintenance access doors tested according to UL 1978 and rated for 500 deg F continuously, or 2000 deg F for 30 minutes; with positive or negative duct pressure and complying with NFPA 211.
1. Door Label: Mark door with uppercase lettering as follows: "ACCESS PANEL. DO NOT OBSTRUCT."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for 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. Coordinate installation of roof curbs, equipment supports, and roof penetrations. Comply with requirements in Section 077200 "Roof Accessories."

B. Coordinate connections to kitchen exhaust hoods with requirements in Section 233813 "Commercial-Kitchen Hoods."

C. Coordinate connections to exhaust fans with requirements in Division 23 Sections.

D. Coordinate firestopping where grease ducts penetrate fire separations with requirements in Section 078413 "Penetration Firestopping."

E. Comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211 and UL 2221, whichever is most stringent.

F. Install airtight maintenance access doors where indicated.

G. Seal between sections of grease exhaust ducts according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

H. Connections: Make grease duct connections according to the International Mechanical Code.

1. Grease duct to exhaust fan connections: Connect grease ducts to inlet side of fan using flanges, gaskets, and bolts.
2. Grease duct to hood connections:

a. Make grease duct to hood joints connections using internal or external continuously welded or brazed joints.
b. Make watertight grease duct to hood joints connections using flanges, gaskets, and bolts.

I. Support ducts at intervals recommended by manufacturer to support weight of ducts and accessories, without applying loading on kitchen hoods.

1. Securely attach supports and bracing to structure.

J. Grease Duct Enclosures: Comply with requirements of the International Building Code and ASTM E 2336.

K. Coordinate fire-rated enclosure construction with Section 092116.23 "Gypsum Board Shaft Wall Assemblies."

L. Repair damage to adjacent materials caused by listed kitchen ventilation system exhaust ducts installation.

3.3 FIELD QUALITY CONTROL

A. Perform air leakage test in presence of Owner before concealment of any portion of the grease duct system.

1. Notify Owner a minimum of 7 days before test is performed.

END OF SECTION 233533

SECTION 233713 - 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 grilles, registers, diffusers, and other air devices

B. Related Sections:

1. Section 089116 "Operable Wall Louvers" and Section 089119 "Fixed Louvers" 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.

B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

A. 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. 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 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the manufacturers specified:
   1. Price Industries.
   2. Titus.

2.2 AIR DEVICES

A. Rectangular and Square Ceiling Grilles, Registers, Diffusers: See schedules for material, finish, size, pattern, damper type, and accessories.

B. Fire rated air devices: Plans indicate a “fire damper” designation on diffusers that need a fire rated air device. Coordinate with plans.

2.3 INSULATION

A. All cold surfaces that are susceptible to condensation shall be insulated.

B. Insulation may be provided by manufacturer or by installing Contractor. Coordinate with installing Contractor.

2.4 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 233813 - COMMERCIAL-KITCHEN HOODS

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 Type I and Type II commercial-kitchen hoods.

B. Related Requirements:

1. Section 233533 "Listed Kitchen Ventilation System Exhaust Ducts" for fire-rated ducts connecting to kitchen hoods.

1.3 DEFINITIONS

A. Listed Hood: A hood, factory fabricated and tested for compliance with UL 710 by a testing agency acceptable to authorities having jurisdiction.

B. Standard Hood: A hood, usually field fabricated, that complies with design, construction, and performance criteria of applicable national and local codes.

C. Type I Hood: A hood designed for grease exhaust applications.

D. Type II Hood: A hood designed for heat and steam removal and for other nongrease applications.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Standard hoods.
2. Filters/baffles.
3. Fire-suppression systems.
4. Lighting fixtures.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Shop Drawing Scale: 1/4 inch = 1 foot.
2. Show plan view, elevation view, sections, roughing-in dimensions, service requirements, duct connection sizes, and attachments to other work.
3. Show cooking equipment plan and elevation to confirm minimum code-required overhang.

4. Indicate performance, exhaust and makeup air airflow, and pressure loss at actual Project-site elevation.
5. Show water-supply and drain piping connections.
6. Show control cabinets.
7. Show fire-protection cylinders, piping, actuation devices, and manual control devices.
8. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
9. Include diagrams for power, signal, and control wiring.
10. Duct Connections: Detail connections between ducts and hoods, including access doors and panels.
11. Piping Diagrams: Detail fire-suppression piping and components and differentiate between manufacturer-installed and field-installed piping. Include roughing-in requirements for drain connections. Show cooking equipment plan and elevation to illustrate fire-suppression nozzle locations.

    a. Piping Diagram Scale: 1/4 inch = 1 foot.

1.5 INFORMATIONAL SUBMITTALS

A. 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. Coordination Drawing Scale: 1/4 inch = 1 foot.
2. Suspended ceiling assembly components.
3. Structural members to which equipment will be attached.
4. Roof framing and support members for duct penetrations.
5. Items penetrating finished ceiling including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Moldings on hoods and accessory equipment.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D 1.1M, "Structural Welding Code - Steel," for hangers and supports; and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for joint and seam welding.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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.

2.2 HOOD MATERIALS

A. Stainless-Steel Sheet: ASTM A 666, Type 304.

1. Minimum Thickness: Double wall, 18 gauge.
2. Finish: Comply with SSINA's "Finishes for Stainless Steel" for recommendations for applying and designating finishes.

    a. Finish shall be free from tool and die marks and stretch lines and shall have uniform, directionally textured, polished finish indicated, free of cross scratches. Grain shall run with long dimension of each piece.

3. Concealed Stainless-Steel Surfaces: ASTM A 480/A 480M, No. 2B finish (bright, cold-rolled, unpolished finish).
4. Exposed Surfaces: ASTM A 480/A 480M, No. 3 finish (intermediate polished surface).
5. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

B. Sealant: ASTM C 920; Type S, Grade NS, Class 25, Use NT. Elastomeric sealant shall be NSF certified for commercial-kitchen hood application. Sealants, when cured and washed, shall comply with requirements in 21 CFR 177.2600, for use in areas that come in contact with food.

1. Color: As selected by Architect from manufacturer's full range.
2. Backer Rod: Closed-cell polyethylene, in diameter larger than joint width.

C. Sound Dampening: NSF-certified, non-absorbent, hard-drying, sound-deadening compound for permanent adhesion to metal in minimum 1/8-inch thickness that does not chip, flake, or blister.

D. Gaskets: NSF certified for end-use application indicated; of resilient rubber, neoprene, or PVC that is nontoxic, stable, odorless, nonabsorbent, and unaffected by exposure to foods and cleaning compounds, and that passes testing according to UL 710.

2.3 GENERAL HOOD FABRICATION REQUIREMENTS

A. Welding: Use welding rod of same composition as metal being welded. Use methods that minimize distortion and develop strength and corrosion resistance of base metal. Make ductile welds free of mechanical imperfections such as gas holes, pits, or cracks.

1. Welded Butt Joints: Full-penetration welds for full-joint length. Make joints flat, continuous, and homogenous with sheet metal without relying on straps under seams, filling in with solder, or spot welding.

2. Grind exposed welded joints flush with adjoining material and polish to match adjoining surfaces.
3. Where fasteners are welded to underside of equipment, finish reverse side of weld smooth and flush.
4. Coat concealed stainless-steel welded joints with metallic-based paint to prevent corrosion.
5. After zinc-coated steel is welded, clean welds and abraded areas and apply SSPC-Paint 20, high-zinc-dust-content, galvanizing repair paint to comply with ASTM A 780/A 780M.

B. For metal butt joints, comply with SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines."

C. Where stainless steel is joined to a dissimilar metal, use stainless-steel welding material or fastening devices.

D. Form metal with break bends that are not flaky, scaly, or cracked in appearance; where breaks mar uniform surface appearance of material, remove marks by grinding, polishing, and finishing.

E. Sheared Metal Edges: Finish free of burrs, fins, and irregular projections.

F. In food zones, as defined in NSF, fabricate surfaces free from exposed fasteners.

G. Cap exposed fastener threads, including those inside cabinets, with stainless-steel lock washers and stainless-steel cap (acorn) nuts.

H. Fabricate pipe slots on equipment with turned-up edges sized to accommodate service and utility lines and mechanical connections.

I. Fabricate enclosures, including panels, housings, and skirts, to conceal service lines, operating components, and mechanical and electrical devices including those inside cabinets unless otherwise indicated.

J. Fabricate equipment edges and backsplashes according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines."

K. Fabricate enclosure panels to ceiling and wall as follows:

1. Fabricate panels on all exposed side(s) with same material as hood, and extend from ceiling to top of hood canopy and from canopy to wall.
2. Wall Offset Spacer: Minimum of 3 inches.
3. Wall Shelves and Overshelves: Fabricate according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines," with minimum 0.0625-inch-thick, stainless-steel shelf tops.

2.4 TYPE I EXHAUST HOOD FABRICATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Captive-Aire Systems.
2. Grease Master.
3. Greenheck Fan Corporation.

B. Weld all joints exposed to grease with continuous welds, and make filters/baffles or grease extractors and makeup air diffusers easily accessible for cleaning.

1. Fabricate hoods according to NSF 2, "Food Equipment."
2. Hoods shall be listed and labeled, according to UL 710, by a testing agency acceptable to authorities having jurisdiction.
3. Hoods shall be designed, fabricated, and installed according to NFPA 96.
4. Include access panels as required for access to fire dampers and fusible links.
5. Duct Collars: Minimum 0.0598-inch-thick steel at least 3 inches long, continuously welded to top of hood and at corners. Fabricate a collar with a 0.5-inch-wide duct flange.
6. Duct-Collar Fire Dampers: Collar and damper shall comply with UL 710 testing and listing required for the entire hood.

    a. Collar: Minimum 0.0598-inch-thick stainless steel, at least 3 inches long, continuously welded to top of hood and at corners. Fabricate a collar with a minimum 0.5-inch-wide duct flange.
    b. Blades: Minimum 0.1046-inch-thick stainless steel, counterbalanced to remain closed after actuation.
    c. Blade Pivot and Spring: Stainless steel.
    d. Fusible Link: Replaceable, 212 deg F rated.

7. Makeup Air Fire Dampers: Labeled, according to UL 555, by a testing agency acceptable to authorities having jurisdiction.

    a. Fire Rating: 1-1/2 hours.
    b. Frame: SMACNA with blades in airstream; fabricated with roll-formed, stainless steel; with mitered and interlocking corners.
    c. Blades: Roll-formed, interlocking or folded, minimum 0.034-inch-thick, galvanized-steel sheet.
    d. Horizontal Dampers: Include a blade lock and stainless-steel closure spring.
    e. Fusible Link: Replaceable,

C. Hood Configuration: Exhaust and makeup air.
1. Makeup air shall be introduced through laminar-flow-type, perforated stainless steel panels on front of hood canopy.

D. Hood Style: Wall-mounted canopy, or as scheduled.

E. Filters/Baffles: Removable**,** aluminum. Exposed surfaces shall be pitched to drain to collection cup. Filters/baffles must be listed and meet UL Standard 1046. Mesh filters are NOT allowed to be used as listed grease filter/baffles. Filters/baffles shall be tested according to UL 1046, "Safety for Grease Filters for Exhaust Ducts," by an NRTL acceptable to authorities having jurisdiction.

A. Lighting Fixtures: U.L. compact fluorescent light fixtures and globes shall be installed and pre-wired to a junction box. The light fixtures shall be installed with a maximum of 4’0" spacing on center. Light switches shall be mounted on front panel of hood canopy.

B. Light switches shall be mounted on front panel of hood canopy.
   1. Lighting Fixtures: Compact fluorescent complying with UL 1598.

C. Hood Controls: Wall-mounting control cabinet, fabricated of stainless steel.

   1. Exhaust Fan: On-off switches shall start and stop the exhaust fan. Interlock exhaust fan with makeup air supply fan to operate simultaneously. Interlock exhaust fan with fire-suppression system to operate fan(s) during fire-suppression-agent release and to remain in operation until manually stopped. Include red pilot light to indicate fan operation. Include spare terminals for fire alarm, and wiring to start fan with fire alarm.

D. Capacities and Characteristics: See construction schedules.

2.5 TYPE II EXHAUST HOOD FABRICATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Captive-Aire Systems.
   2. Grease Master.
   3. Greenheck Fan Corporation.

B. Fabricate hoods according to NSF 2, "Food Equipment."

C. Fabricate hoods to comply with SMACNA's "HVAC Duct Construction Standards: Metal and Flexible."

D. Hood Configuration: Exhaust only.

E. Hood Type: Heat and vapor removal.

F. Hood Style: Wall-mounted canopy or as indicated.

G. Condensate Hood Baffles: Removable, stainless-steel baffles to drain into a hood drain trough, and stainless-steel drain piping.

H. Lighting Fixtures: U.L. listed compact fluorescent fixtures and lamps with lenses sealed vapor tight. Wiring shall be installed in stainless-steel conduit on hood exterior. Number and location of fixtures shall provide a minimum of 70 fc at 30 inches above finished floor.

   1. Light switches shall be mounted on front panel of hood canopy.
   2. Lighting Fixtures: Compact fluorescent complying with UL 1598.

I. Capacities and Characteristics: See construction documents.

2.6 WET-CHEMICAL FIRE-SUPPRESSION SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ansul Incorporated; a Tyco International Ltd. Company.
2. Approved NFPA 96 equal.

B. Description: Engineered distribution piping designed for automatic detection and release or manual release of fire-suppression agent by hood operator. Fire-suppression system shall be listed and labeled for complying with NFPA 17A, "Wet Chemical Extinguishing Systems," by a qualified testing agency acceptable to authorities having jurisdiction.

1. Steel Pipe, NPS 2 and Smaller: ASTM A 53/A 53M, Type S, Grade A, Schedule 40, plain ends.
2. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
3. Piping, fusible links and release mechanism, tank containing the suppression agent, and controls shall be factory installed. Controls shall be in stainless-steel control cabinet mounted on hood or wall. Furnish manual pull station for wall mounting. Exposed piping shall be covered with chrome-plated aluminum tubing. Exposed fittings shall be chrome plated.
4. Liquid Extinguishing Agent: Noncorrosive, low-pH liquid.
5. Furnish electric-operated gas shutoff valve with clearly marked open and closed indicator for field installation.
6. Fire-suppression system controls shall be integrated with controls for fans, lights, and fuel supply and located in a single cabinet for each group of hoods immediately adjacent.
7. Wiring shall have color-coded, numbered terminal blocks and grounding bar. Spare terminals for fire alarm, optional wiring to start fan with fire alarm, red pilot light to indicate fan operation, and control switches shall all be factory wired in control cabinet with relays or starters. Include spare terminals for fire alarm, and wiring to start fan with fire alarm.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate equipment layout and installation with adjacent Work, including lighting fixtures, HVAC equipment, plumbing, and fire-suppression system components.

B. Complete field assembly of hoods where required.

1. Make closed butt and contact joints that do not require filler.

2. Grind field welds on stainless-steel equipment smooth, and polish to match adjacent finish. Comply with welding requirements in "General Hood Fabrication Requirements" Article.

C. Install hoods and associated services with clearances and access for maintaining, cleaning, and servicing hoods, filters/baffles, grease extractor, and fire-suppression systems according to manufacturer's written instructions and requirements of authorities having jurisdiction.

D. Make cutouts in hoods where required to run service lines and to make final connections, and seal openings according to UL 1978.

E. Securely anchor and attach items and accessories to walls, floors, or bases with stainless-steel fasteners unless otherwise indicated.

F. Install hoods to operate free from vibration.

G. Install trim strips and similar items requiring fasteners in a bed of sealant. Fasten with stainless-steel fasteners at 48 inches o.c. maximum.

H. Install sealant in joints between equipment and abutting surfaces with continuous joint backing unless otherwise indicated. Provide airtight, watertight, vermin-proof, sanitary joints.

I. Install lamps, with maximum recommended wattage, in equipment with integral lighting.

J. Set initial temperatures, and calibrate sensors.

K. Set field-adjustable switches.

3.3 CONNECTIONS

A. Where installing piping adjacent to hoods, allow space for service and maintenance.

B. Connect ducts according to requirements in Section 233300 "Air Duct Accessories." Install flexible connectors on makeup air supply duct. Weld exhaust-duct connections with continuous liquidtight joint.

C. Install fire-suppression piping for remote-mounted suppression systems according to NFPA 17A, "Wet Chemical Extinguishing Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test each equipment item for proper operation. Repair or replace equipment that is defective, including units that operate below required capacity or that operate with excessive noise or vibration.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3. Test water, drain, gas, and liquid-carrying components for leaks. Repair or replace leaking components.
4. Perform hood performance tests required by authorities having jurisdiction.
5. Perform fire-suppression system performance tests required by authorities having jurisdiction.

B. Commercial-kitchen hoods will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial-kitchen hoods.

END OF SECTION 233813

SECTION 237413 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

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 high efficiency, packaged rooftop units with direct-expansion cooling, electric-heating coils, roof curbs, integral, space temperature controls. Provide single zone single zone operation where indicated.

B. Where indicated, and where DOAS does not provide pretreated fresh air, provide units with hot-gas reheat, dehumidification mode, and economizer outdoor- air damper section with CO2 based DCV. Economizer shall meet the latest IECC requirements.

C. Refer to Div. 7 Specifications for roof curbs, restraints and attachments, and related delegated design scope of work.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design RTU supports to comply with **wind** performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Wind-Restraint Performance rated for basic Wind Speed: Rated for the location.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's technical data for each model indicated, 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. Prepare the following by or under the supervision of a qualified professional engineer:

1. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
2. Structural members to which RTUs will be attached.
3. Roof openings
4. Roof curbs and flashing.
5. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Wind Loading Qualification Certification: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article and in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force 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.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

F. Warranty: Special warranty specified in this Section.

G. Certified Compliance Statement and shop drawings from a licensed PE for IBC and TDI.
1. Sealed shop drawings showing installation instructions and attachment of equipment to curb, and curb to structure. Include quantity and type of restraining brackets/clips, screws, spacing, etc.
2. As a separate attachment provide sealed IBC and TDI compliant calculations for curbs and attachment.

1.5 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 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. ARI Certification: Units shall be ARI certified and listed.

E. ARI Compliance for Units with Capacities Less Than 135,000 Btuh: Rate rooftop air-conditioner capacity according to ARI 210/240, "Unitary Air-Conditioning and Air-Source Heat Pump Equipment."

1. Sound Power Level Ratings: Comply with ARI 270, "Sound Rating of Outdoor Unitary Equipment."

F. ARI Compliance for Units with Capacities 135,000 Btuh and More: Rate rooftop air-conditioner capacity according to ARI 340/360, "Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment."

1. Sound Power Level Ratings: Comply with ARI 270, "Sound Rating of Outdoor Unitary Equipment."

G. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

H. UL Compliance: Comply with UL 1995.

I. 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.

J. International Building Code and TDI Compliance: Licensed Professional Engineer shall certify that the listed items are designed for and will withstand wind speed for the location of the project, per the relevant edition of International Building Code, ASCE Std 7, Texas Department of Insurance requirements.
1. Equipment curb/attachment for exterior and roof mounted equipment such as RTUs, ACCU, fans.
2. Attachment of equipment to curb/pad.
3. Attachment of curb/pad to building structure.

1.6 COORDINATION

A. Coordinate size, location, and installation of rooftop air-conditioner manufacturer's roof curbs and equipment supports with roof installer.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.7 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.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
2. Warranty Period for Integrated Control System: Manufacturer's standard, but not less than three years from date of Substantial Completion.
3. Warranty Period for all other components: Manufacturer's standard, but not less than one year from date of Substantial Completion.

1.8 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. Fan Belts: **One set** for each belt-drive fan (if applicable)
2. Filters: **One set** of filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
1. Lennox Industries Inc.
2. Trane
3. Carrier (Basis of Design)
4. Aaon
5. Substitutions: As indicated under the general and/or supplemental conditions of these specifications. Mechanical contractor shall be responsible for electrical, mechanical, and structural changes when using a product other than the specified product. As built drawing changes is the responsibility of the mechanical contractor.

2.2 CONSTRUCTION

A. General Fabrication Requirements for Casings: Galvanized-steel construction with enamel paint finish, removable panels or access doors with neoprene gaskets for inspection and access to internal parts, minimum 1/2-inch- thick thermal insulation with foil face and no insulation exposed to air stream, knockouts for electrical and piping connections, exterior condensate drain connection, and lifting lugs. Unit cabinet surface shall be tested 500 hours in salt spray test in compliance with ASTM B117. Cabinet top cover shall be one-piece construction or where seams exit, it shall be double-hemmed and gasket-sealed.

A. Indoor Fan: Forward curved, double width, double inlet, centrifugal, direct drive (ECM) motor on 3 thru 6 ton units, belt driven motor 7.5 tons and above. Fan motor to allow MSAV (Multi stage air volume) to allow air delivery to unload with compressor. Provide self-aligning, grease lubricated, ball or sleeve bearings with permanent lubrication fittings. If belt driven fans are provided, fans shall have with adjustable motor sheaves.

B. Condenser Fan: Propeller type, directly driven by motor.

C. Motors: Permanently lubricated and have internal thermal overload protection. Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

D. Refrigerant: R410A.

E. Refrigerant Coils: Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.

1. Provide an independent expansion device for each refrigeration circuit. Factory pressure tested at 450 psig and leak tested at 150 psig.
2. Provide factory installed thermal expansion valve (TXV) for each refrigerant circuit. Factory pressure tested at 450 psig and leak tested at 150 psig.
3. Provide stainless-steel or non-corrosive plastic drain pan under indoor coil. Galvanized steel drain pans are not acceptable.
4. Condenser coil shall be supplied with hail guards.
5. **Provide corrosion-protection coating to condenser coils. Acceptable coating include factory applied phenolic epoxy (E-COAT or TECHNICOAT), or certified Energy Guard Coating. Coating to have a minimum 6,000 hr ASTMB117 Salt Spray rating.**

F. Compressor: Scroll compressor with integral vibration isolators or rubber grommet mounts, internal overcurrent and overtemperature protection, integral centrifugal oil pump, suction gas cooled motor, internal pressure relief, and crankcase heater.

G. Refrigeration System:

1. Compressor.
2. Condenser coil and fan.
3. Evaporator coil and fan.
4. Hot gas reheat coil (where indicated).
5. Expansion valve with replaceable thermostatic element.
6. Refrigerant dryer.
7. High-pressure switch.
8. Low-pressure switch.
9. Thermostat for coil freeze-up protection during low-ambient temperature operation or loss of air.
10. Low-ambient switch.
11. Charge of refrigerant.
12. Timed Off Control: Automatic-reset control shuts compressor off after five minutes.

H. Filter Frame: Galvanized steel with metal grid on outlet side for use with MERV 8 filter media, steel rod grid on inlet side, hinged access, and with pull and retaining handles.

I. Electric Heat: Helix-wound, nickel-chrome, electric-resistance elements, and factory wired for single-point wiring connection; with time delay for element staging, and overcurrent and overheat protective devices. Heater shall have pilot duty or automatic reset line voltage limit controls and any circuit carrying more than 48 amps shall have fuse protection in compliance with N.E.C. Heater shall be UL listed and approved and provide single point power connection.

J. Dampers (where indicated): Return- and outside-air dampers with neoprene seals, outside-air filter, bird screen and hood.

1. Damper Motor: Damper motor shall be direct coupled, gear driven, 24 volt, fully modulating (0-100%) design with adjustable minimum position.
2. Control: Electronic-control system uses CO2 sensor to adjust outside air dampers.

K. Power Connection: Single connection of power to unit with control-circuit transformer with built-in circuit breaker.

L. Unit Controls: Solid-state control board and components contain at least the following features:

1. Indoor fan on/off delay.
2. Default control to ensure proper operation after power interruption.
3. Service relay output.
4. Unit diagnostics and diagnostic code storage.
5. Field-adjustable control parameters.
6. Dehumidification control with dehumidistat.
7. Electric heat staging.
8. Indoor-air quality and outside air control with carbon dioxide sensor.
9. Low-ambient control, allowing operation down to 0 deg F.
10. Minimum run time.
11. Night setback mode.
12. Return-air temperature limit.
13. Smoke alarm with smoke detector installed in return air for units larger than 2000 CFM.
14. Low-refrigerant pressure control.
15. Digital display of outside temperature, supply-air temperature, return-air temperature, economizer damper position, indoor-air quality, and control parameters.
16. Provide factory-installed indoor evaporator defrost control to prevent compressor slugging by interrupting compressor operation.

M. Optional Accessories:
1. Copper condensate drain trap by contractor.
2. Economizer Mode with Controls to meet latest IECC requirements.
3. **Louvered** hail guards of steel, painted to match casing.
4. Controls and control sensors.
5. Stainless steel or non-corrosive plastic drain pans.
6. Condenser coil coating.
7. Adequate insulation on all cold surfaces to prevent condensation.
8. Factory mounted controller with full digital text display of sensor readings and diagnostics.
9. Hinged access doors with quarter-turn handles for tool-less entry into compressor compartment, filter/mixing box section and fan/heater section.
10. Provide dual stage compressors or dual compressors on units 5-tons and smaller and dual speed blower and condenser fan motors.

N. Fan Motor: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.3 ROOF CURBS

A. Roof Curb: Galvanized steel, 16 gauge zinc with corrosion-protection coating, supply and return air watertight gasketing, and factory-installed wood nailer; complying with NRCA standards; minimum height of 18 inches.
1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
a. Materials: ASTM C 1071, Type I or II.
b. Thickness: **2 inches**.

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
a. Liner Adhesive: Comply with ASTM C 916, Type I.

b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
d. Liner Adhesive: Comply with ASTM C 916, Type I.

B. Wind Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site.

2.4 DEHUMIDIFICATION SYSTEM

A. Provide units with hot-gas reheat coil for dehumidification. Hot-liquid reheat coils are unacceptable. The option shall consist of a hot-gas reheat coil located on the leaving side of the evaporator coil pre-piped and circuited. The option shall be equipped with a crankcase heater(s), high and low pressure switches, and thermostatic expansion valves (TXV). It allows the unit to operate in a dehumidification cycle when the space relative humidity limit is exceeded. When space humidity is below the preset limit, the unit operates in its' normal cooling mode.

B. Shall be capable of simultaneously operating both the non hot-gas reheat compressor circuits and hot-gas reheat compressor circuits of multiple compressor units when both the humidity level and the first stage cooling temperature level exceed their set points.

C. Shall be capable of prioritizing a cooling (or heating) demand over a dehumidification demand and shut off the hot-gas reheat coil circuit(s) to meet the temperature requirements. Shall be capable of turning the hot-gas reheat coil back on if the dehumidification demand still exists after the cooling (or heating) demand has been met.

D. Shall consist of a reheat coil, three-way solenoid valve, a check valve (to prevent reverse flow of refrigerant during cooling operation) and associated copper piping.

E. Reheat coil shall be constructed with enhanced aluminum fins mechanically bonded to copper tubes. Fin count shall not exceed 14 fins per inch.

F. Reheat coil shall be sized to provide 20-25 degrees F of reheat. Manufactures must be able to demonstrate sufficient reheat required to provide neutral dry air, minimum of 17°F at 55°Fdischarge air temperature.

2.5 MOTORIZED OUTDOOR AIR DAMPER

A. Shall be available factory or field installed internal to the unit to provide motorized operation of outdoor air requirements.

B. Outside air dampers shall be controlled by the main unit microprocessor based control board. This board shall be located in the main control compartment and not the outdoor section of the unit.

C. Construction
1. Shall be fully modulating (0-100%) complete with low leakage outside air dampers and controls.
2. Damper motor shall be direct coupled, gear driven, 24 volt, fully modulating (0-100%) design.
3. Outdoor air hood with filters shall be provided and constructed of G90 galvanized steel with a 0.20 – 0.30 mils urethane primer and 0.70 - 0.80 mils polyester coat on the top side and a 0.15 – 0.25 mils urethane primer and 0.20 to 0.30 mils. polyester coat on the back side. Coating shall be resistant to 500 hours of salt spray per ASTM B-117; 500 hours of humidity exposure per ASTM D2247; and 168 hours of heat resistance per ASTM D3454. Coating shall be impact resistant per ASTM D2794; Abrasion resistant per ASTM D4060; and Solvent resistant per NCCA No. II-18. Coating shall have H minimum pencil hardness per ASTM D3363. Coating shall have a 3T no tape pick off Flexibility per NCCAII-19. Coating shall have a “no tape pick off” cross hatch adhesion resistance per ASTM D3359.

D. Demand Control Ventilation (DCV)
1. Shall have selectable programs for demand control ventilation when optional CO2 sensor is installed using either a set point or proportional control sequence.
2. Shall have a default maximum percent travel of 100% for DCV operation. This position shall be adjustable from 0 to 100%.
3. Shall start to open the damper if the CO2 level is 700 ppm or greater. This set point shall be adjustable from 0 to 2000 ppm.
4. Shall put the damper at 100% of travel if the CO2 level is 1000 ppm or greater. This set point shall be adjustable from 0 to 2000 ppm.
5. Shall start closing the damper if the outdoor temperature is 35°F or lower. This low temperature set point shall be adjustable from -31°F to 132°F.
6. Shall put the damper at minimum position if the outdoor temperature is 105°F or higher. This high temperature set point shall be adjustable from -31°F to 132°F.

2.6 CONTROLS

A. Cooling Controls

1. Shall support up to two stages of cooling from a factory installed DDC controller without the need for any additional controls.
2. Shall allow a blower on delay of up to 60 seconds after a cooling demand is received. The default value is zero.
3. Shall allow a blower off delay of up to 240 seconds after a cooling demand has ended. The default value is zero.
4. Shall have a minimum compressor on time of 3 minutes
5. Shall have a minimum compressor off time of 5 minutes
6. Unit shall incorporate a solid state compressor lockout with optional reset capability at the space thermostat should any of the following Saftey devices trip:
   a. Compressor Lockout Protection
   b. Low or High Pressure Switch
   c. Freeze protection
   d. Compressor reverse rotation
   e. Loss of charge protection

7. Shall record an error in non-volatile memory with each pressure switch trip occurrence (either high or low) and identify the compressor circuit.
8. Shall have a low outdoor air temperature compressor lock out set point of 0°F (-18°C) for each compressor circuit. This low outdoor temperature limit set point shall be individually adjustable for each compressor circuit from 80°F (-27°C) to -30°F (-34°C).
9. The Open controller will cycle condenser fans as needed to maintain proper performance. Operation of the condenser fan is not adjustable.

B. Heating Controls
1. Shall support two stages of heating control from a factory installed DDC Controller without the need for any additional controls.
2. Shall turn the supply fan on 40 seconds after a heating demand is received. This time delay shall be adjustable from 8 to 60 seconds.
3. Shall turn the supply fan off 120 seconds after a heating demand has ended. This time delay shall be adjustable from 80 to 300 seconds.
4. Shall have a delay time of 30 seconds between stages. This time delay shall be adjustable from 30 to 160 seconds.
5. Shall have a heat off delay of 100 seconds after the thermostat heating demand has ended. This heat off delay shall be adjustable from 30 to 300 seconds.
6. Shall turn off the heat and keep the supply air fan running if an over heat limit occurs
7. Shall report an error with each occurrence of an over heat limit trip and identify the limit that tripped. Error code shall be stored in non-volatile memory.
8. Shall turn off the heat if the induced air flow is too low and report an error identifying the pressure switch.

C. Supply Air Fan Control
1. Shall have continuous or automatic control for occupied periods.
2. Shall have adjustable on/off delay for both cooling and heating operation

D. Microprocessor Based Unit Controller
1. Integrated DDC type, solid state, microprocessor based control board shall be provided to control all operations of the unit.
2. Shall have a blinking LED to indicate normal operation.
3. Shall have LEDs to indicate a thermostat demand mode.
4. Shall have a push button to reset the board. Push button shall also allow user to select pre-programmed functions or view sensor input values or diagnostic fault codes or view the firmware version.
5. Shall have a LED to indicate data transmission along the network.
6. Shall have provision to select the operating mode of the unit.
7. Shall have a test mode to allow quick operation checks with shorter delays for mode changes.
8. Shall have provision to set unit type and voltage phase.
9. Shall have provision to set unit network address.
10. Shall have RS-485 or RS-232 communication port for connection with a PC to use the optional interface software.
11. Shall have a 3 wire network bus connection terminal.
12. Shall report and error if a power failure occurs on the main control board or any of the daughter control boards. The digital output for service shall also be activated.
13. Shall report and error if a communication failure occurs on the main control board or any of the daughter control boards. The digital output for service shall also be activated.

14. Shall report an error if the outdoor air sensor fails and shall default control operation to the high outdoor air limits.
15. Shall allow for sensor calibration.
16. Thermostat Operation
    a. Shall be 2 stage heat/2 stage cool zone sensor capable when used with Building Automation System.
    b. Shall have a night set back (unoccupied) mode
    c. Shall have thermostat bounce delay of 3 seconds.
    d. Shall have return air limit control for either heating or cooling operation.
    e. Shall have an automatic change over time delay of 5 minutes between heating and cooling operation or visa versa. This time delay shall be adjustable from 1 to 15 minutes.
17. Diagnostics
    a. Shall have 80 diagnostic fault codes. See cooling, heating, fan and unit control sections for detailed error codes.
    b. Shall store up to 80 of the most recent diagnostic fault codes in non-volatile memory
18. Shall have 32 Digital Inputs for the following:
    a. Occupied mode
    b. Low cool demand
    c. High cool demand
    d. Low heat demand
    e. High heat demand
    f. Supply fan demand
    g. Smoke detector demand
    h. Phase monitor or loss of phase switch
    i. Dirty filter indicator
    j. Supply air proving indicator
    k. Primary heat limit 1
    l. Primary heat limit 2
    m. Secondary heat limit 1
    n. Secondary heat limit 2
    o. Low pressure switch 1
    p. Low pressure switch 2
    q. Low pressure switch 3
    r. Low pressure switch 4
    s. High pressure switch 1
    t. High pressure switch 2
    u. High pressure switch 3
    v. High pressure switch 4
    w. Freeze protection switch 1
    x. Freeze protection switch 2
    y. Freeze protection switch 3
    z. Freeze protection switch 4
19. Shall have 6 Analog Inputs for the following:
    a. Return air temperature sensor
    b. Supply air temperature sensor
    c. Outdoor air temperature sensor
    d. Zone Temperature Sensor
    e. Return air Relative humidity sensor
    f. Return air CO2 sensor

20. Shall have 18 Digital Outputs for the following:
    a. Supply air fan motor
    b. Compressor 1
    c. Compressor 2
    d. Condenser Fan 1
    e. Condenser Fan 2
    f. Condenser Fan 3
    g. Condenser Fan 4
    h. Condenser Fan 5
    i. Condenser Fan 6
    j. Heat 1
    k. Heat 2
    l. Heat 3
    m. Heat 4
    n. Critical diagnostic fault code occurrence
21. Display: May be provided at the unit, or at the Central Operator Station, or via the world wide web.
    a. Shall have three digit display for diagnostic codes and sensor readings
    b. Shall display return air, supply air and outdoor air temperatures.
    c. Shall display return air, supply air and outdoor air temperature in °F or °C
    d. Shall display RH if optional sensor installed.
    e. Shall display CO2 ppm level if optional sensor installed.
    f. Shall display zone temperature if optional zone sensor is installed.
    g. Shall display damper position if optional economizer or motorized outdoor air damper is installed.
22. Fresh air temperature control
    a. Shall have selectable program for warming cold fresh ventilation air using first stage heat
    b. Shall activate first stage of heating if supply air temperature falls below the selected temperature set point. The temperature set point range shall be from 40°F to 70°F.
    c. The temperature at which first stage heating is turned off shall be 20°F (11°C) above the set point. This deadband shall be adjustable from 10°F (5.5°C) to 20°F.
    d. The minimum cycle time for this heating operation shall be 8 minutes. This run time shall be adjustable from 2 to 30 minutes.
23. Loss of Phase or Brown Out Protection
    a. A 24V digital input shall be available to initiate unit shut down upon activation.

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. Examine roofs for suitable conditions where RTUs will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Roof Curb: Install on roof structure, level and secure, according to Architectural and Roofing manufacturer's recommendation. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Division 07 Section "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing with anchor bolts.

B. Install wind restraints according to manufacturer's written instructions.

3.3 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

B. Install piping adjacent to RTUs to allow service and maintenance.

C. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination at top of roof curb.
2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
3. Connect supply ducts to RTUs with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."
4. Terminate return-air duct through roof structure and insulate space between roof and bottom of unit with 2-inch- thick, acoustic duct liner.

D. Electrical System Connections: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.

E. Ground equipment according to Division 26 Section "Grounding and Bonding."

F. 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.

3.4 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.

3.5 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. Adjust fan belts to proper alignment and tension.
13. Start unit according to manufacturer's written instructions.

    a. Start refrigeration system.
    b. Complete startup sheets and attach copy with Contractor's startup report.

14. Inspect and record performance of interlocks and protective devices; verify sequences.
15. Operate unit for an initial period as recommended or required by manufacturer.
16. Calibrate thermostats.
17. Adjust and inspect high-temperature limits.
18. Inspect outdoor-air dampers for proper stroke.
19. 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.

20. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
21. 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.

22. 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.

23. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

    a. High-temperature limit on heater.
    b. Low-temperature safety operation.
    c. Filter high-pressure differential alarm.
    d. Economizer to minimum outdoor-air changeover.
    e. Smoke and firestat alarms.

24. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 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.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 237413

SECTION 237433 - DEDICATED OUTDOOR-AIR UNITS

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 factory-packaged units capable of supplying up to 100 percent outdoor air and providing cooling and heating. DOAS unit includes high efficiency, packaged rooftop units with direct-expansion cooling, hot gas reheat coils, electric heaters in reheat position, variable speed drives, roof curbs, integral, space temperature controls, and economizer section with motorized OA and RA dampers.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design RTU supports to comply with **wind** performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Wind-Restraint Performance rated for basic Wind Speed: Rated for project location.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Prepare the following by or under the supervision of a qualified professional engineer:

    a. Mounting Details: For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
    b. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For design of vibration isolation and wind restraints, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Unit fabrication and assembly details.

2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
3. Design Calculations:

    a. Calculate requirements for selecting vibration isolators and wind restraints and for designing vibration isolation bases.
    b. Indicate compliance with "Performance Requirements" article.

D. Manufacturer Wind Loading Qualification Certification: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article, Division 7 and in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force 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.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof-curb mounting 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. Size and location of unit-mounted rails and anchor points and methods for anchoring units to roof curb.
2. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.

B. Certified Compliance Statement and shop drawings from a licensed PE for IBC and TDI.
1. Sealed shop drawings showing installation instructions and attachment of equipment to curb, and curb to structure. Include quantity and type of restraining brackets/clips, screws, spacing, etc.
2. As a separate attachment provide sealed IBC and TDI compliant calculations for curbs and attachment.

C. Startup service reports.

D. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

A. AHRI Compliance:

1. Comply with AHRI 210/240 and AHRI 340/360 for testing and rating energy efficiencies for RTUs.

2. Comply with AHRI 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 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. AHRI Certification: Units shall be AHRI certified and listed. Certification and listing shall be verified by AHRI website.

E. AHRI Compliance for Units with Capacities 135,000 Btuh and More: Rate rooftop air-conditioner capacity according to AHRI 340/360, "Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment."

1. Sound Power Level Ratings: Comply with AHRI 270, "Sound Rating of Outdoor Unitary Equipment."

F. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

G. UL Compliance: Comply with UL 1995.

H. 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.

I. International Building Code and TDI Compliance: Licensed Professional Engineer shall certify that the listed items are designed for and will withstand wind speed for the location of the project, per the relevant edition of International Building Code, ASCE Std 7, Texas Department of Insurance requirements.
1. Equipment curb/attachment for exterior and roof mounted equipment such as RTUs, ACCU, fans.
2. Attachment of equipment to curb/pad.
3. Attachment of curb/pad to building structure.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For units 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. Fan Belts: One set for each belt-driven fan.

2. Filters: One set for each unit.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
2. Warranty Period for Integrated Control System: Manufacturer's standard, but not less than three years from date of Substantial Completion.
3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than 3 years from date of Substantial Completion.
4. Warranty Period for all other components: Manufacturer's standard, but not less than one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AAON. (Design Basis)
2. Desert Aire.
3. Engineered Air.
4. Munters Corporation.

2.2 PERFORMANCE REQUIREMENTS

A. General Fabrication Requirements: Comply with requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."

B. Delegated Design: Engage a qualified professional engineer, as defined in Div. 7 to design vibration isolation and wind restraints.

C. Wind-Restraint Performance:

1. Basic Wind Speed: Coordinate with Structural.
2. Building Classification Category: Coordinate with Structural.
3. Minimum 10 lb/sq. ft multiplied by the maximum area of unit projected on a vertical plane that is normal to the wind direction and 45 degrees either side of normal.

D. Cabinet Thermal Performance:

1. Maximum Overall U-Value: Comply with requirements in ASHRAE/IESNA 90.1.
2. Include effects of metal-to-metal contact and thermal bridges in the calculations.

E. Cabinet Surface Condensation:

1. Cabinet shall have additional insulation and vapor seals if required to prevent condensation on the interior and exterior of the cabinet.
2. Portions of cabinet located downstream from the cooling coil shall have a thermal break at each thermal bridge between the exterior and interior casing to prevent condensation from occurring on the interior and exterior surfaces. The thermal break shall not compromise the structural integrity of the cabinet.

F. Maximum Cabinet Leakage: 0.5 percent of the total supply-air flow at a pressure rating equal to the fan shut-off pressure.

G. Cabinet Deflection Performance:

1. Walls and roof deflection shall be within L/240 of the span at the design working pressure equal to the fan shut-off pressure. Deflection limits shall be measured at any point on the surface.
2. Floor deflections shall be within L/240 of the span considering the worst-case condition caused by the following:

a. Service personnel.
b. Internal components.
c. Design working pressure defined for the walls and roof.

H. 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.

I. Capacities and Characteristics: See schedules

2.3 CABINET

A. Construction: double wall.

B. Exterior Casing Material: Galvanized steel with paint finish.

C. Interior Casing Material: Galvanized.

D. Interior and Exterior Corrosion Protection Paint Finish: Pain finish shall meet or exceed 2500hour Salt Spray Test per ASTM B117 95, with no visible corrosive effect, when tested in a salt spray and fog atmosphere. Air tunnel, supply fans, and dampers shall be included in the corrosion protection.

E. Lifting and Handling Provisions: Factory-installed shipping skids and lifting lugs.

F. Base Rails: Galvanized-steel rails for mounting on roof curb or pad as indicated.

G. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

1. Service Doors: Hinged access doors with gaskets. Material and construction of doors shall match material and construction of cabinet in which doors are installed.

H. Roof: Standing seam or membrane; sloped to drain water.

I. Floor: Reinforced, metal surface; reinforced to limit deflection when walked on by service personnel. Insulation shall be below metal walking surface.

J. Cabinet Insulation:

1. Type: flexible elastomeric insulation complying with ASTM C 534, Type II, sheet materials.
2. Thickness: 2 inches R-13.
3. Insulation Adhesive: Comply with ASTM C 916, Type I.
4. Mechanical Fasteners: Suitable for adhesive, mechanical, or welding attachment to casing without damaging liner and without causing air leakage when applied as recommended by manufacturer.

K. Condensate Drain Pans:

1. Shape: Rectangular, with 2 percent slope in at least two planes to direct water toward drain connection.
2. Size: Large enough to collect condensate from cooling coils including coil piping connections, coil headers, and return bends.
    a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
    b. Depth: A minimum of 2 inches deep.
3. Configuration: Double wall, with space between walls filled with foam insulation and moisture-tight seal.
4. Material: Stainless-steel sheet.
5. Drain Connection:
    a. Located on one end of pan, at lowest point of pan.
    b. Terminated with threaded nipple.
6. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

L. Surfaces in Contact with Airstream: Comply with requirements in ASHRAE 62.1 for resistance to mold and erosion.

M. Roof Curb: Full-perimeter curb of sheet metal, minimum 18 inches high, with wood nailer, neoprene sealing strip, and welded Z-bar flashing.

1. Comply with requirements in "The NRCA Roofing Manual."

N. Service Doors: Access to filters, dampers, cooling coils, reheat coil, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles and neoprene gaskets. Full length stainless steel piano hinges shall be included on the doors.

2.4 SUPPLY FAN

A. Fan: Direct drive, unhoused, backward curved, centrifugal, plenum supply fan. Factory installed VARIABLE SPEED DRIVE motors to provide true variable air volume operation based on static pressure sensing.

B. Motor: TEFC, premium efficiency motor with a factory wired and mounted variable speed drive in RTU cabinet.

C. Drive: Direct drive only. Belt drive not permitted.

D. Factory installed variable frequency drive (VFD) with “classic” manual bypass. See Variable Frequency Drive specification section for VFD requirements.

E. Mounting: Fan wheel, motor, and drives shall be mounted on rubber isolators.

2.5 COOLING COILS

A. Capacity Ratings: Comply with ASHRAE 33 and ARI 410 and coil bearing the ARI label.

B. Coil Casing Material: Stainless steel.

C. Tube Material: Copper.

D. Tube Header Material: Copper.

E. Fin Material: Aluminum.

F. Fin and Tube Joints: Mechanical bond.

G. Leak Test: Coils shall be leak tested with air underwater.

H. Refrigerant Coil Capacity Reduction: Circuit coils for intertwined control.

I. Refrigerant Coil Suction and Distributor Header Materials: Seamless copper tube with brazed joints.

J. Coating: Phenolic epoxy corrosion-protection coating after assembly.

2.6 REFRIGERATION SYSTEM

A. Comply with requirements in ASHRAE 15, "Safety Standard for Refrigeration Systems."

B. Refrigerant Charge: Factory charged with refrigerant and filled with oil.

C. Compressors: Scroll compressor with integral vibration isolators or rubber grommet mounts, internal overcurrent and overtemperature protection, suction gas cooled motor, internal pressure relief, and crankcase heater.

1. Units shall include a variable capacity scroll compressor on the lead refrigeration circuit which shall be capable of modulation from 10-100% of its capacity for true variable load modulation.
2. Units 9 Tons and greater shall be provided with fixed scroll compressor on the lag refrigeration circuit and factory installed hot gas bypass to protect against evaporator frosting and to prevent excessive compressor cycling.

D. Refrigerant: R-410A.

1. Classified as Safety Group A1 according to ASHRAE 34.
2. Provide unit with operating charge of refrigerant.

E. Refrigeration System Specialties:

1. Expansion valve with replaceable thermostatic element.
2. Refrigerant dryer.
3. High-pressure switch.
4. Low-pressure switch.
5. Thermostat for coil freeze-up protection during low ambient temperature operation or loss of air.
6. Brass service valves installed in discharge and liquid lines.
7. Liquid sight glass.
8. Liquid line receivers.
9. Reversing valves.
10. Check valves.
11. Modulating hot gas reheat valves.

F. Capacity Control:
1. Unit shall include a variable capacity scroll compressor on the lead refrigeration circuit(s) which shall be capable of modulation from 10-100% of its capacity.

G. Modulating Hot Gas Reheat Dehumidification: Lead refrigeration circuit(s) shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a dehumidification control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space.

H. Refrigerant Coils: Evaporator, condenser, and reheat condenser coils shall be designed, tested, fabricated, and rated according to ARI 410 and ASHRAE 33. Coils shall be leak tested under water with air at 315 psig. Thermal expansion valve and hot gas reheat shall be factory piped. The expansion valve shall have adjustable superheat. The outside air face velocity cannot exceed 172 feet per minute through the evaporator coil.

I. Coils:

1. Capacity Reduction: Circuit coils for face control.
2. Tubes: Copper.
3. Fins: Aluminum with minimum fin spacing of 0.071 inch.
4. Fin and Tube Joint: Mechanical bond.
5. Suction and Distributor: Seamless copper tube with brazed joints.
6. Source Quality Control: Test to 450 psig, and to 300 psig underwater.

7. Evaporator and Condenser Coil Coating: Coil shall have a flexible epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 6,000 hours salt spray per ASTM B117-90. Coated coils shall receive a spray-applied, UV-resistant polyurethane topcoat to prevent UV degradation of the e-coat. Coating shall carry a 5 year warranty, from the date of original equipment shipment from the factory.

J. Condenser Fan: Propeller type, directly driven by motor with first capacity stage shall be provided with on/off condenser fan cycling and adjustable compressor lockout to allow cooling operation down to 35°F. Condenser fans shall be VFD driven variable speed for condenser head pressure control. Factory provided and factory programmed VFDs shall continuously modulate the fan air flow to maintain head pressure at acceptable levels. Cooling operation shall be allowed down to 35°F with adjustable compressor lockouts.

K. Safety Controls:

1. Compressor motor and outside-coil fan motor low ambient lockout.
2. Overcurrent protection for compressor motor and outside-coil fan motors.

2.7 ELECTRIC-RESISTANCE HEATING COIL

A. UL Compliance: Comply with requirements in UL 1995, "Heating and Cooling Equipment."

B. Electric-Resistance Heating Elements:

1. Open Coiled Resistance Wire: 80 percent nickel and 20 percent chromium.
2. Supports and Insulation: Floating ceramic bushings recessed into casing openings; fastened to supporting brackets and mounted in galvanized-steel frame.
3. Tubular-Steel Sheath: Compacted magnesium oxide powder.
4. Fins: Spiral-wound, copper-plated, steel fins continuously brazed to sheath.
5. Heating Capacity: Low density 35 W per sq. in., factory wired for single-point wiring connection; with time delay for element staging and overcurrent- and overheat-protection devices.
6. Safety Controls:

    a. Blower-motor interlock, air-pressure switch.
    b. Quiet mercury contactors.
    c. Time delay between steps.
    d. Integral, nonfused power disconnect switch.

2.8 OUTDOOR-AIR INTAKE HOOD

A. Type: Manufacturer's standard hood or louver.

B. Materials: Match cabinet.

C. Bird Screen: Comply with requirements in ASHRAE 62.1.

D. Configuration: Designed to inhibit wind-driven rain from entering unit.

2.9 OUTDOOR-AIR DAMPERS

A. All Dampers: Unit shall include 100% motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge and end seals. Damper blades shall be gear driven and designed to meet smoke damper Class-1 leakage specifications in accordance with U.L. 555S at 4 inches w.g. air pressure differential across the damper. Damper assembly shall be controlled by spring return, modulating actuator. Unit shall include outside air opening bird screen and outside air hood.

B. Damper Operators: Electric.

C. Economizer mode operation to meet IECC requirements.

2.10 FILTERS

A. Cleanable Filters: 2-inch-thick, cleanable metal mesh.

B. Comply with NFPA 90A.

A. Galvanized steel with metal grid on outlet side for use with MERV 8 filter media, steel rod grid on inlet side, hinged access, and with pull and retaining handles.

B. Mounting Frames:

1. Panel filters arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or from access plenum.
2. Extended surface filters arranged for flat orientation, removable from access plenum.
3. Galvanized or stainless steel with gaskets and fasteners, suitable for bolting together into built-up filter banks with space for prefilter.

2.11 ELECTRICAL POWER CONNECTIONS

A. General Electrical Power Connection Requirements: Factory-installed and -wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.

B. Enclosure: NEMA 250, Type 4XSS, mounted in unit with hinged access door in unit cabinet having a lock and key or padlock and key,

C. Wiring: Numbered and color-coded to match wiring diagram.

D. Wiring Location: Install factory wiring outside an enclosure in a raceway.

E. Power Interface: Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch. See Div. 26 specifications.

F. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:

1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.

G. Factory-Mounted, Overcurrent-Protection Service: For each motor.

H. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.

I. Controls: Factory wire unit-mounted controls where indicated.

J. Receptacle: Factory wire unit-mounted, ground fault interrupt (GFI) duplex receptacle, where indicated.

K. Control Relays: Auxiliary and adjustable time-delay relays.

2.12 CONTROLS

A. Control equipment and sequence of operation are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

B. Control Wiring: Factory wire connection for controls' power supply.

C. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, actuators, and valves shall be manufacturer's standard items to accomplish indicated control functions.

D. Internally wired electrical controls shall include the compressor motor contactors or starters with thermal protection (auto-reset) on all inductive loads. Refrigerant controls are to include a high pressure control (manual-reset) low suction pressure control (auto-reset), field adjustable refrigerant system lockout and compressor anti-short cycle timer. Provide controls kit for field mounting and wiring to include blower motor and contactor.

E. Factory Installed Unit Controls: Solid-state control board and components with field-adjustable control parameters.

F. Remote and Unit-Mounted Status Panel:

1. Cooling/Off/Heating Controls: Control operational mode.
2. Damper Position: Indicate position of outdoor-air dampers in terms of percentage of outdoor air.
3. Status Lights:

a. Filter dirty.
b. Fan operating.
c. Cooling operating.
d. Heating operating.
e. Smoke alarm.
f. General alarm.

4. Digital Numeric Display:

    a. Outdoor airflow.
    b. Supply airflow.
    c. Outdoor dry-bulb temperature.
    d. Outdoor dew point temperature.
    e. Discharge air temperature.
    f. Discharge air relative humidity.
    g. Space carbon dioxide level.

G. Control Dampers:

1. Damper Location: Factory installed inside unit for ease of blade axle and bushing service. Arrange dampers located in a mixing box to achieve convergent airflow to minimize stratification.
2. Damper Leakage: Comply with requirements in AMCA 500-D. Leakage shall not exceed 6.5 cfm per sq. ft. at a static-pressure differential of 4.0 inches water column when a torque of 5 inch pounds per sq. ft. is applied to the damper jackshaft.
3. Damper Rating: Rated for close-off pressure equal to the fan shutoff pressure.
4. Damper Label: Bear the AMCA seal for both air leakage and performance.
5. Blade Configuration: Unless otherwise indicated, use parallel blade configuration for two-position control and equipment isolation service and use modulating control when mixing two airstreams. For other applications, use an opposed-blade configuration.
6. Damper Frame Material: Extruded aluminum.
7. Blade Type: hollow-shaped airfoil.
8. Blade Material: Extruded aluminum.
9. Maximum Blade Width: 6 inches.
10. Maximum Blade Length: 48 inches.
11. Blade Seals: Replaceable, continuous perimeter vinyl seals and jambs with stainless-steel compression-type seals.
12. Bearings: Thrust bearings for vertical blade axles.

H. Damper Operators:

1. Factory-installed electric operator for each damper assembly with one operator for each damper assembly mounted to the damper frame.
2. Operator capable of shutoff against fan pressure and able to operate the damper with sufficient reserve power to achieve smooth modulating action and proper speed of response at the velocity and pressure conditions to which the damper is subjected.
3. Maximum Operating Time: Open or close damper 90 degrees in 60 seconds.
4. Adjustable Stops: For both maximum and minimum positions.
5. Position Indicator and Graduated Scale: Factory installed on each actuator with words "OPEN" and "CLOSED," or similar identification, at travel limits.
6. Spring-return operator to fail-safe; either closed or open as required by application.
7. Operator Type: Direct coupled, designed for minimum 60,000 full-stroke cycles at rated torque.
8. Position feedback Signal: For remote monitoring of damper position.
9. Coupling: V-bolt and V-shaped, toothed cradle.
10. Circuitry: Electronic overload or digital rotation-sensing circuitry.

I. Refrigeration System Controls:

1. Unit-mounted enthalpy controller shall lock out refrigerant system when outdoor-air enthalpy is less than 28 Btu/lb of dry air or outdoor-air temperature is less than 60 deg F.
2. Outdoor-air sensor de-energizes dehumidifier operation when outdoor-air temperature is less than 55 deg F.
3. Relative-humidity sensor energizes dehumidifier operation when relative humidity is more than 50 percent.

J. Electric-Resistance Heat Controls:

1. Factory-mounted sensor in unit discharge with sensor adjustment located in control panel to control electric coil to maintain temperature.
2. Capacity Controls: Modulating SCR.

K. Integral Smoke Alarm: Smoke detector installed in return air. Coordinate with fire alarm system.

L. DDC Temperature Control: Standalone control module for link between unit controls and DDC temperature-control system. Control module shall be compatible with control system specified in Section 230923 "Direct Digital Control (DDC) System for HVAC." Links shall include the following:

1. Start/stop interface relay, and relay to notify DDC temperature-control system alarm condition.
2. Hardware interface or additional sensors for the following:

    a. Room temperature (average, minimum and maximum for zones).
    b. Discharge-air temperature.
    c. Refrigeration system operating.
    d. Heater operating.
    e. Constant and variable motor loads.
    f. Variable-frequency-controller operation.
    g. Cooling load.
    h. Economizer cycles.
    i. Air-distribution static pressure and ventilation-air volumes.

M. Interface with DDC System for HVAC: Factory-installed hardware and software to enable the DDC system for HVAC to monitor, control, and display unit status and alarms.

1. Hardwired Points:

    a. Monitoring: On-off status, common trouble alarm.
    b. Control: On-off operation, supply temperature set-point adjustment.

2. ASHRAE 135 (BACnet) communication interface with the DDC system for HVAC shall enable the DDC system for HVAC operator to remotely control and monitor the unit from an operator workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the DDC system for HVAC.

2.13 ACCESSORIES

A. Duplex Receptacle: Factory mounted in unit supply-fan section, with 20 amp 120 V GFI duplex receptacle and weatherproof cover.

B. Copper condensate drain trap.

C. Louvered hail guards of steel, painted to match casing, or Vee shaped condenser coils that are inherently guarded against hail.

D. Controls and control sensors.

E. 304 Stainless steel drain pans.

F. Evaporator and Condenser coil coating: Factory applied flexible epoxy polymer corrosion-protection coating.

G. Adequate insulation on all cold surfaces to prevent condensation.

H. Hinged access doors with ¼ turn handles at filter, fan, controls/compressor sections.

I. Provide economizers and other accessories to meet with requirements of IECC 2012.

J. Provide interface module with LCD screen and input keypad to access, unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling.

K. Wind Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site.

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 the Work.

B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.

B. Curb Support: Install roof curb on roof structure according to "The NRCA Roofing Manual."

1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction.
2. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."
3. Coordinate size, location, and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.

C. Restrained Curb Support: Install restrained vibration isolation roof-curb rails on roof structure according to "The NRCA Roofing Manual."

D. Equipment Mounting:
1. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

E. Install wall- and duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.

F. Install separate devices furnished by manufacturer and not factory installed.

G. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

H. Install drain pipes from unit drain pans to sanitary drain.

1. Drain Piping: Drawn-temper copper water tubing complying with ASTM B 88, Type L, with soldered joints.
2. Drain Piping: Schedule 40 PVC pipe complying with ASTM D 1785, with solvent-welded fittings.
3. Pipe Size: Same size as condensate drain pan connection.

3.3 CONNECTIONS

A. Where installing piping adjacent to units, allow space for service and maintenance.

B. Duct Connections:

1. Comply with requirements in Section 233113 "Metal Ducts."
2. Drawings indicate the general arrangement of ducts.
3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 233300 "Air Duct Accessories."

C. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.

1. Install electrical devices furnished by unit manufacturer but not factory mounted.

D. Install piping adjacent to RTUs to allow service and maintenance.

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.
2. Inspect units for visible damage to furnace combustion chamber.
3. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
4. Start refrigeration system when outdoor-air temperature is within normal operating limits and measure and record the following:
    a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
    b. Cooling coil entering-air, dry- and wet-bulb temperatures.
    c. Condenser coil entering-air dry-bulb temperature.
    d. Condenser coil leaving-air dry-bulb temperature.
5. Simulate maximum cooling demand and inspect the following:
    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.
6. Inspect casing insulation for integrity, moisture content, and adhesion.
7. Verify that clearances have been provided for servicing.
8. Verify that controls are connected and operable.
9. Verify that filters are installed.
10. Clean coils and inspect for construction debris.
11. Inspect and adjust vibration isolators and seismic restraints.
12. Verify bearing lubrication.
13. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
14. Adjust fan belts to proper alignment and tension.
15. Start unit.
16. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
17. Operate unit for run-in period.
18. Calibrate controls.
19. Adjust and inspect high-temperature limits.
20. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
21. Verify operational sequence of controls.
22. Measure and record the following airflows. Plot fan volumes on fan curve.
    a. Supply-air volume.
    b. Return-air flow.
    c. Outdoor-air flow.

B. After startup, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.

D. Prepare written report of the results of startup services.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 237433

SECTION 238126 - 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. Section includes split-system air-conditioning units consisting of separate evaporator-fan and compressor-condenser components.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ACCU supports to comply with **wind** performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Wind-Restraint Performance rated for basic Wind Speed: Rated for Brownsville, Texas.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

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.

C. Manufacturer Wind Loading Qualification Certification: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article, Division 7 and in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force 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.

D. Field quality-control reports.

E. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

F. Warranty: Sample of special warranty.

G. Certified Compliance Statement and shop drawings from a licensed PE for IBC and TDI.
   1. Sealed shop drawings showing installation instructions and attachment of equipment to curb, and curb to structure. Include quantity and type of restraining brackets/clips, screws, spacing, etc.
   2. As a separate attachment provide sealed IBC and TDI compliant calculations for curbs and attachment.

1.5 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 Compliance:

   1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
   2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-Up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.

D. International Building Code and TDI Compliance: Licensed Professional Engineer shall certify that the listed items are designed for and will withstand wind speed for the location of the project, per the relevant edition of International Building Code, ASCE Std 7, Texas Department of Insurance requirements.
   1. Equipment curb/attachment for exterior and roof mounted equipment such as RTUs, ACCU, fans.
   2. Attachment of equipment to curb/pad.
   3. Attachment of curb/pad to building structure.

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

1.7 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. Warranty period to commence from the date of equipment start-up.

1. Warranty Period:
   a. For Compressor: **Five** year(s) from date of Substantial Completion.
   b. For Parts and Labor: **One** year(s) from date of Substantial Completion.

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. Filters: **One** set for each air-handling unit.
   2. Fan Belts: **One** set for each air-handling unit fan.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Trane.
   2. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.
   3. Lennox International Inc.
   4. YORK; a Johnson Controls company.

2.2 INDOOR UNITS 5 TONS OR LESS

A. Vertical, Evaporator-Fan Components: An assembly including cabinet, filter, chassis, coil, drain pan, fan, and motor in blow-through configuration with direct-expansion cooling coil, and electric heating coil, where scheduled.

B. Cabinet: Covers and access panels shall be manufactured of 20 gauge pre- painted, galvanized sheet metal. Cabinet walls shall have insulated panels, fabricated to allow removal for access to internal parts and components. Units shall be designed and equipped for installation indoors.

C. Chassis: Unit structural members shall be manufactured of 16 gauge pre-painted, galvanized sheet metal. Removable panels for servicing, and insulation on back of panel.
   1. Insulation: Standard insulation or minimum 1”, whichever is greater.

D. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.

E. Reheat Coil: If scheduled, unit shall include a hot gas reheat coil with a modulating reheat control valve and an electronic controller. The valve position shall be controlled to provide a specific supply air temperature setpoint that is set on the control board or sent to the control board by a remote 0-10 Vdc signal.

F. Electric Coil: If scheduled, 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 over-current protection.

G. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   1. Special Motor Features: Multi-tapped, multi-speed with internal thermal protection and permanent lubrication.
   2. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   3. Enclosure Type: Totally enclosed, fan cooled.
   4. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
   5. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
   6. Mount unit-mounted disconnect switches on unit.

H. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

I. Condensate Drain Pans:
   1. Fabricated with slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
      a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1-2004.
      b. Depth: A minimum of 1 inch deep.
      c. Stainless-steel sheet or non-corrosive plastic, insulated.
      d. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
   2. Air Filtration Section:
      a. General Requirements for Air Filtration Section:
         1) Comply with NFPA 90A.
         2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
         3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
      b. Filters:
         1) Factory-fabricated, viscous-coated, flat-panel type.
         2) Thickness: **2 inches**.
         3) Merv according to ASHRAE 52.2: 8.
         4) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
         5) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:
   1. Casing: Corrosion free pre-painted steel cabinet, finished with baked enamel, 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.

2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

    a. Compressor Type: Scroll, mounted on rubber mounts for vibration isolation.
    b. Two-stage (where scheduled) compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
    c. Refrigerant Charge: **R-407C** or **R-410A**.
    d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 210/240.
    e. Internal excessive current and temperature protection.
3. Fan: Aluminum-propeller type, directly connected to motor.
4. Motor: Permanently lubricated, with integral thermal-overload protection.

2.4 ACCESSORIES

A. Programmable Thermidistat with the following features:
1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature and RH, set-point temperature and RH, time setting, operating mode, and fan speed.

B. Other:
1. Direct driven ECM fan motor, and with built in dehumidification sequence option for indoor units.
2. Low Ambient Controller: Cycles condenser fan to permit operation down to 35 deg F with time-delay relay to bypass low-pressure switch.
3. Package with refrigerant circuit suction and discharge gauges, and service valves.
4. Automatic-reset timer to prevent rapid cycling of compressor.
5. Site glass, filter-dryer.
6. High-Pressure Switch: Automatic-reset switch cycles compressor off on high refrigerant pressure.
7. Low-Pressure Switch: Automatic-reset switch cycles compressor off on low refrigerant pressure.
8. Thermostatic expansion valve to match with existing Evaporator Coil, if existing is incompatible.
9. Time-Delay Relay: Continues operation of evaporator fan after compressor shuts off.
10. Evaporator defrost controller.
11. Liquid line solenoid valves, electric unloaders, factory/field installed accumulators to accomplish stages of unloading.
12. See drawing schedules.

C. Unit Casing: Galvanized steel, finished with paint finish capable of withstanding at least 1000 hours when tested in salt spray atmosphere (ASTM B 117- 95 test procedure); with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Mount service valves, fittings, and gage ports on exterior of casing.
1. Condenser coil louvered hail guard to protect coil from physical damage.
2. Condenser coil coating: epoxy coat or Energy Guard
3. Wind Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site.

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-mounted, compressor-condenser components on 4-inch- thick, reinforced concrete base that is 4 inches 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 refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

E. Provide auxiliary drain pans with float switches to disable fans. Provide drain piping with stop valves from pans to floor drains.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

C. Duct Connections: Duct installation requirements are specified in Division 15 Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Division 15 Section "Duct Accessories."

D. Ground equipment according to Division 16 Section "Grounding and Bonding."

E. Electrical Connections: Comply with requirements in Division 16 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, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

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.

D. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Verify that air-conditioning units are installed and connected according to manufacturer's written instructions and the Contract Documents.
1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
3. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
4. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
5. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
6. Comb coil fins for parallel orientation.
7. Verify that proper thermal-overload protection is installed for electric coils.
8. Install new, clean filters.
9. Verify that manual and automatic volume control and fire and smoke dampers in connected
10. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
11. Measure and record motor electrical values for voltage and amperage.

C. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.

D. Complete installation and startup checks according to manufacturer's written instructions.

E. After startup service and performance test, change filters.

F. Manually operate dampers from fully closed to fully open position and record fan performance.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 260010 - SUMMARY OF ELECTRICAL WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections and other Division 26 Specification Sections, apply to this Section.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, as is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.

B. Scope of Work:

1. General: The **"IDEA Robindale Phase I"** consists of new two-story building, approximate 79,000 s.f. This building will generally be operated from 7:00am to 6:00pm. (Monday through Friday) with occasional after hours and weekends use.
2. Electrical: Provide all materials and labor associated with complete operational electrical distribution system. Major items of work include, but are not limited to:

(a) Electrical service:

(i) Provide a new underground electrical service; it shall consist of underground electrical raceways and concrete pad for Utility furnished transformer.

(ii) Utility company shall provide medium voltage conductors and pad transformer.

(iii) Single phase protection: provide as noted on switchboard and panels schedules.

(b) Lighting systems: Interior and exterior lighting system shall consist of LED type.

(c) Lighting controls (switches, occupancy sensors, daylight sensors, etc.): provide as noted on plans specifications. In some cases, they will be ceiling mounted and others wall mounted. It's the intent for them to be wired to automatically control the luminaires in their respective areas.

(d) Commissioning: Provide for the lighting equipment and lighting controls as required per IECC 2015.

(e) Power systems: Provide miscellaneous duplex receptacles, isolated ground receptacles for computer terminals, duplex receptacles for flat screens connections, and power for marquee/building signs, banking, H.V.A.C. and plumbing equipment.

(f) Fire Alarm System:

(i) Provide an addressable control panel with voice evacuation, cell/wireless monitoring, manual and automatic initiation devices. Monitoring and interfacing with elevator, fire sprinkle tamper and flow switches. Indicating devices shall also be provided to comply with TDLR.

(ii) Fully coordinate with the Elevator Contractor for the Fire Alarm interfacing.

(iii) Fully coordinate with the food service contractor for the kitchen hood fire suppression interfacing.

(g) Communication and data processing equipment: Provide rough-ins only. Cabling, connectors, patch panels, racks, etc. by owner.

(h) Multimedia system: Provide rough-ins for multimedia outlet and flat screens. Connectors, cabling and outlets by owner.

(i) School Intercom System: Provide speakers and call-in switches in classrooms and offices. Hallways and building exterior walls with speakers to transmit general announcements.

(j) Gymnasium Sound System: Provide central speaker, microphone outlets, microphone, microphone stands, and wiring. See specifications.

(k) Cafeteria Sound System: Provide pendant mounted speakers, microphone outlets, microphone, microphone stands, and wiring. See specifications.

(l) Intrusion Detection System: It shall consist of a control panel with wireless/radio monitoring, keypads, glass break sensors, motion detectors and magnetic contacts as noted on drawings.

(m) Building access: provide power to vehicle and pedestrian gates, reception area entrance door magnetic strikes and intercom and camera at vehicle gates entrance.

1.3 ALLOWANCES

A. Electrical: See Division 1 for electrical allowances.

1.4 COORDINATION

A. All electrical work shall be done under sub-contract to a General Contractor, who ultimately responsible for the entire project. Electrical Contractor shall coordinate all work through General Contractor, even in areas where only electrical work is to take place.

B. All questions, requests for information, submittals, and correspondence from the Electrical Contractor shall be submitted via the General Contractor, who will forward to the Architect, who will then forward to the Engineer.

C. Electrical Contractor shall not make any changes to design without written authorization from the Engineer. If changes are requested by the Owner, Architect, General Contractor, Suppliers, Manufacturers, or any others, Contractor should issue a written RFI for response by the Engineer.

D. Electrical Contractor shall issue seven (7) days written notice prior to any activities that require the presence of the Engineer at the job-site. This applies to all inspections required by specifications, and particularly to those where work will be covered (underground raceways, electrical raceways above ceiling).

E. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.

F. Fully coordinate with Mechanical Contractor for providing power to HVAC systems and plumbing equipment.

G. Fully coordinate with the Plumbing and Millwork contractors for the science lab equipment installation.

H. Fully coordinate with the Elevator Contractor for the elevator equipment installation.

I. Fully coordinate with the Food Service Contractor for the equipment installation.

J. Issue written notification of the following tasks and allow five (5) days for Engineer to respond and schedule an inspection as required:

1. Upon completion of underground raceways installation and prior to covering up.
2. Upon completion of installing all raceways, labeling all j-boxes and prior to suspended ceiling installation.
3. Upon completion of pulling all wiring, making all terminations, labeling and color-coding wires at the panelboards/switchboards and prior to installing their covers.
4. When ready to request manufacturer's start-up of each piece of equipment.
5. When ready to conduct complete Fire Alarm, School Intercom, Cafeteria and Gymnasium Sound Systems, and Intrusion Detection demonstrations.
6. When ready for Substantial Completion Inspection.
7. When ready for Final Inspection.

Failure to issue written notification may result in work having to be redone to allow for proper inspection. It is this contractor's responsibility to make sure Engineer receives notification.

K. Voice-data communications systems: this work shall be provided by others (not part of this contract). Fully cooperate/coordinate with this contractor for his cabling, outlets (connectors), cable tray, racks (UPS, fans), and etc. installation.

1.5 UTILITIES

1. Coordinate with power, water, telephone, cable and gas utilities to locate all utilities prior to digging in any area.
2. Obtain any approvals required from utilities to relocate utilities.
3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.
4. Coordinate with utility for electrical service. Base bid shall include all costs associated with service connection, including permit fees.

1.6 CONTRACTOR USE OF PREMISES

A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.

1. Owner Occupancy: Allow for Owner occupancy and use by the public.
2. Driveways and Entrances: Keep driveways and entrances serving the premises, clear and available to the Owner, the Owner's employees, and emergency vehicles at all time. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:

1. Temporary fencing around construction areas.

2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
3. Temporary fencing around equipment while site work is in progress.

C. Work shall take place with minimal disruption to Owner's operations in areas surrounding the job site.

1.7 SUBMITTALS -Special Requirements

A. Manufacturer's standard dimensioned drawings, performance and product data shall be edited to delete reference to equipment, features, or information, which is not applicable to the equipment being supplied for this project. Including Bill or List of Materials.

B. Faxes and copies of faxes are not acceptable.

C. Electrical Submittals shall be submitted electronically. **Please organize the files as noted below** (PDF format - searchable). Files would need to be properly identified (cover letter, stamped, etc.) from the general contractor.

1. Miscellaneous Electrical – Submittal #1
   a. 260519 Low-Voltage Electrical Power Conductors and Cables
   b. 260526 Grounding and Bonding for Electrical Systems
   c. 260529 Hangers and Supports for Electrical Systems
   d. 260533 Raceways and Boxes for Electrical Systems
   e. 260553 Identification for Electrical Systems
   f. 260544 Sleeves and Sleeve Seals for Electrical Raceways and Cabling
   g. 262726 Wiring Devices
   h. 260850 Hand Dryer

2. Electrical Gear– Submittal #2
   a. 262200 Low Voltage Transformers
   b. 262413 Switchboards
   c. 262416 Panelboards
   d. 262813 Fuses
   e. 262816 Enclosed Switches and Circuit Breakers
   f. 262913 Enclosed Controllers
   g. 264313 Surge Protection for Low-Voltage Electrical Power Circuit

3. Electrical Studies– Submittal #3
   a. 260572 Overcurrent Protective Device Short-Circuit Study
   b. 260574 Arch Flash Study

4. Light Fixtures– Submittal #4
   a. 265116 Interior Lighting
   b. 265219 Emergency and Exit Lighting
   c. 265613 Lighting Poles and Standards
   d. 265621 Exterior Lighting
   e. 260923 Light Control Devices
   f. 260943.23 Relay Based Lighting Control

5. Special Systems: – Submittal #5

a. 267210 Fire Alarm System
b. 267230 School Intercom
c. 267260 Gymnasium Sound System
d. 267265 Cafeteria Sound System
e. 267270 Public Address
f. 267240 Intrusion Detection System

6. Electrical Commissioning – Submittal #6

a. 260800 Commissioning for Electrical Systems

E. Individual submittals shall not be reviewed until a complete package is received.

F. Allow two weeks for initial submittal review by Engineer, from the day it is received at the Engineer's office.

G. Allow one week for review of resubmittals by Engineer.

H. All submittal review comments shall be forwarded by Engineer to Architect, who will then distribute as per Division 1.

1.8 SCHEDULE OF VALUES -Special Requirements

A. Electrical Contractor shall submit a Schedule of Values reflecting the total value of Electrical Work in the Contract and broken down into the following items as a minimum, with a line item for Materials/Equipment and another for Labor.

ELECTRICAL

1. Electrical gear.
2. Electrical coordination and arch flash study.
4. Interior raceways including wiring.
5. Interior Light fixtures
6. Exterior light fixtures
7. Wiring devices.
8. Fire alarm system
9. School intercom
10. Gymnasium Sound reinforcement system.
11. Cafeteria Sound reinforcement system
12. Intrusion detection.
13. Commissioning
14. Allowances.
15. Miscellaneous.
16. Administrative and project management.

1.9 CODE COMPLIANCE:

The design for this project is based on:

1. Occupational Safety and Health Act (OSHA)
2. National Electric Code (NEC)
3. National Fire Code
4. International Building Code

5. UL 916
6. Local ordinances

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. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

A. VFC: Variable frequency controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member Company of NETA or an NRTL.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturer:

1. Senator Wire & Cable Company.
2. Southwire Company.
3. Encore Wire

B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN/THWN-2, Type XHHW-2 and Type SO.

D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC and Type SO with ground wire.

E. VFC Cable:

1. Comply with UL 1277, UL 1685, and NFPA 70 for Type TC-ER cable.
2. Type TC-ER with oversized cross-linked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire or dual spirally wrapped copper tape shields and three bare symmetrically applied ground wires, and sunlight- and oil-resistant outer PVC jacket.
3. Comply with UL requirements for cables in [Classes I and II, Division 2 hazardous location] applications.

2.2 CONNECTORS AND SPLICES

A. Manufacturers:

1. AFC Cable Systems, Inc.
2. AMP Incorporated/Tyco International.
3. Hubbell/Anderson.
4. O-Z/Gedney; EGS Electrical Group LLC.
5. 3M Company; Electrical Products Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

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 NFPA 70.

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, except VFC cable, which shall be extra flexible stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and underground: Type THHN/THWN-2, single conductors in raceway.

E. Feeders Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.

F. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and underground: Type THHN/THWN-2, single conductors in raceway.

I. Branch Circuits Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.

J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, and strain relief device at terminations to suit application.

K. VFC Output Circuits: Type XHHW-2 in metal conduit, Type TC-ER cable with braided shield or with dual tape shield as indicated by VFC manufacturer.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. 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.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, which will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports 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-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 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."

3.7 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."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements.

a. MDF and IDF equipment feeder/branch circuit.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

    a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
    b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

B. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

C. Cables will be considered defective if they do not pass tests and inspections.

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 and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Ground bonding common with lightning protection system.
3. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Ground rods.
2. Ground rings.
3. Grounding arrangements and connections for separately derived systems.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section "Operation and Maintenance Data," include the following:

a. Instructions for periodic testing and inspection of grounding features at ground rings and grounding connections for separately derived systems based on and NFPA 70B.

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. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: 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 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 wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be 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.

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 **exothermic**-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 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 below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches 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 equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches 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; 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 AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 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 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 above to 6 inches 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.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.5 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. 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. 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 and Heat-Tracing 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. 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.

H. Metallic Fences: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare, tinned copper, not less than No. 3 AWG.
2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.6 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 Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches 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.

D. 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.

E. 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.

F. 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.

G. 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 apart.

H. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each indicated item, 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 from building's foundation.

3.7 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 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, 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. Section Includes:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

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 the following:

a. Hangers.
b. Steel slotted support systems.
c. Nonmetallic support systems.
d. Trapeze hangers.
e. Clamps.
f. Turnbuckles.
g. Sockets.
h. Eye nuts.
i. Saddles.
j. Brackets.

2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Trapeze hangers. Include product data for components.
2. Steel slotted-channel systems.
3. Nonmetallic slotted-channel systems.
4. Equipment supports.

1.4 INFORMATIONAL SUBMITTALS

A. 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. Suspended ceiling components.
2. Structural members to which hangers and supports will be attached.
3. Size and location of initial access modules for acoustical tile.
4. Items penetrating finished ceiling, including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Projectors.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M.
2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D 635.

2.2 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.
g. Wesanco, Inc.

2. Material: Plain steel.
3. Channel Width: 1-1/4 inches.
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
8. Channel Dimensions: Selected for applicable load criteria.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored 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 made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

E. 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. 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.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
    a. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
    b. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
    c. Toggle Bolts: All-steel springhead type.
    d. Hanger Rods: Threaded steel.
    e. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
    f. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
    g. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
    h. Toggle Bolts: All-steel springhead type.
    i. Hanger Rods: Threaded steel

2.3 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 Section 055000 "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 unless requirements in this Section are stricter.

B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs and RMCs as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in] NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted 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 two-bolt conduit clamps.

E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch 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, EMTs, and RMCs may be supported by openings through structure members, according to 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.

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.
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 thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Spring-tension clamps.
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 the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Architectural 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 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 Sections "Cast-in-Place Concrete" or "Miscellaneous Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

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. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Sections "Exterior Painting", "Interior Painting" and "High-Performance Coatings" 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 - RACEWAYS 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. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. IMC: Intermediate metal conduit.

C. EMT: Electrical metallic tubing.

D. ENT: Electrical nonmetallic tubing.

E. EPDM: Ethylene-propylene-diene terpolymer rubber.

F. FMC: Flexible metal conduit.

G. LFMC: Liquidtight flexible metal conduit.

H. LFNC: Liquidtight flexible nonmetallic conduit.

I. NBR: Acrylonitrile-butadiene rubber.

J. RNC: Rigid nonmetallic conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. 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.
10. Hylsa

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

E. EMT: Comply with ANSI C80.3 and UL 797.

F. FMC: Comply with UL 1; zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

    a. Material: die cast.
    b. Type: compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

I. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. 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. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.; Pipe & Plastics Group.
6. Condux International, Inc.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. RNC: Type EPC-40-PVCcomplying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. LFNC: Comply with UL 1660.

E. RTRC: Comply with UL 1684A and NEMA TC 14.

F. Fittings for and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

G. Fittings for LFNC: Comply with UL 514B.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. 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.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 3R unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, 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.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hoffman.
2. Lamson & Sessions; Carlon Electrical Products.

B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

2.5 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Thomas & Betts Corporation.
b. Walker Systems, Inc.; Wiremold Company (The).
c. Wiremold Company (The); Electrical Sales Division.
d. Panduit.

C. Tele-Power Poles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Wiremold Company (The); Electrical Sales Division.
b. Panduit
2. Material: Aluminum with clear anodized finish.
3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of 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. Spring City Electrical Manufacturing Company.
10. Thomas & Betts Corporation.
11. Walker Systems, Inc.; Wiremold Company (The).

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

E. Metal Floor Boxes:

1. Material: sheet metal.

2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

G. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

K. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep.

L. Gangable boxes are allowed as along is permitted by the NEC.

M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 for indoor applications and Type 3R (stainless steel) outdoor 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: Fiberglass.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

N. Cabinets:

1. NEMA 250, Type 1, Type 3R galvanized-steel or 4XSS 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.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. 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.
3. Standard: Comply with SCTE 77.
4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
7. Cover Legend: Molded lettering, "ELECTRIC".
8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
9. Handholes 18 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.

3. Underground Conduit: RNC, Type EPC-40-PVC.
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 or Type 4SS as noted on plans.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:

    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.
    d. Gymnasiums.

3. Concealed in Ceilings and Interior Walls and Partitions: EMT
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
5. Damp or Wet Locations: GRC.
6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 1/2-inch trade size.

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. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches 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.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached.

I. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from RNC, Type EPC-40-PVC TO EMT or GRC before rising above floor.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. 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.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Surface Raceways:

1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

T. Install raceway sealing fittings at accessible locations according to NFPA 70 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 according to NFPA 70.

U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

W. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC conduit that is located where environmental

temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.

2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    d. Attics: 135 deg F.
    e. .

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, 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 or LFNC in damp or wet locations not subject to severe physical damage.

Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Z. 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. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

BB. Locate boxes so that cover or plate will not span different building finishes.

CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

EE. Set metal floor boxes level and flush with finished floor surface.

FF. 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 3 for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 3."
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 of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 3."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

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 sieve to No. 4 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 above finished grade.

D. Install handholes with bottom below 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 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 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. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings 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. Section 078413 "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.

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 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 and with no side larger than 16 inches, thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

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:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: Nitrile (Buna N 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 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

2.4 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, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 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 150 g/L or 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 Section 079200 "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 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 annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. 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 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.

1.2 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Colors for Cables Carrying Circuits at 600 V and Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical- resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

E. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

F. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical- resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.

C. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

D. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.5 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 grommets in corners for mounting.
3. Nominal size, 7 by 10 inches.

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 10 by 14 inches.

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."

2.6 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
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.

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. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.7 EQUIPMENT IDENTIFICATION LABELS

A. 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. Overlay shall provide a weatherproof and UV-resistant seal for label.

B. 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.

C. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in 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. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Apply identification devices to surfaces that require finish after completing finish work.

C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

E. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.

F. 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 maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

H. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Install labels at 30-foot 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.
2. Power.
3. UPS.
4. Fire Alarm System
5. Fire-Suppression Supervisory and Control System
6. Security System
7. Mechanical and Electrical Supervisory System
8. Telecommunication System.
9. Control Wiring.

C. Power-Circuit Conductor Identification: For secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

D. 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.

    c. Colors for 480/277-V Circuits:

        1) Phase A: Brown.
        2) Phase B: Orange.
        3) Phase C: Yellow.

    d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches 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.

E. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags with the conductor or cable designation, origin, and destination.

G. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes with the conductor designation.

H. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

I. 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.

J. 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.

K. 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.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self- adhesive warning labels.

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.

M. 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.

N. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer and load shedding.

O. 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: Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
b. Outdoor Equipment: Engraved, laminated acrylic or melamine label Stenciled legend 4 inches high.
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, electrical cabinets, and enclosures.

b. Access doors and panels for concealed electrical items.
c. Electrical switchgear and switchboards.
d. Transformers.
e. Emergency system boxes and enclosures.
f. Motor-control centers.
g. Disconnect switches.
h. Enclosed circuit breakers.
i. Motor starters.
j. Push-button stations.
k. Power transfer equipment.
l. Contactors.
m. Remote-controlled switches, dimmer modules, and control devices.
n. Power-generating units.
o. Voice and data cable terminal equipment.
p. Master clock and program equipment.
q. Intercommunication and call system master and staff stations.
r. Fire-alarm control panel and annunciators.
s. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
t. Uninterruptible power supply equipment.
u. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.

3.3 INSTALLATION

Verify identity of each item before installing identification products.

END OF SECTION 260553

SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT 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. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals may be in digital form.

1. Short-circuit study input data, including completed computer program input data sheets.
2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.

    a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Short-Circuit Study Software Developer and Short-Circuit Study Specialist.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.6 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 unacceptable.

B. Short-Circuit Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

A. Coordination-Study Specialist Qualifications: An organization experienced in the application of computer software used for studies having performed successful studies of similar magnitude on electrical distribution systems using similar devices and being in this type service/business for at least 10 years.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

A. Computer Software Developers: Subject to compliance with requirements, provide computer software programs developed by one of the following:

1. CYME International, Inc.
2. EDSA Micro Corporation.
3. Electrical Systems Analysis, Inc.
4. SKM Systems Analysis, Inc.

B. Comply with IEEE 399 and IEEE 551.

C. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Comments and recommendations for system improvements, where needed.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
5. 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.

F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.

G. Short-Circuit Study Output:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. Calculated asymmetrical fault currents:

        1) Based on fault-point X/R ratio.
        2) Based on calculated symmetrical value multiplied by 1.6.
        3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. No AC Decrement (NACD) ratio.
    e. Equivalent impedance.
    f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
    g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Obtain all data necessary for the conduct of the study.

1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
3. For relocated equipment that which is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.

B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for Project's overcurrent protective devices 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. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
9. Motor horsepower and NEMA MG 1 code letter designation.
10. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.
2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:

1. Electric utility's supply termination point.
2. Incoming switchgear.

3. Unit substation primary and secondary terminals.
4. Low-voltage switchgear.
5. Motor-control centers.
6. Control panels.
7. Standby generators and automatic transfer switches.
8. Branch circuit panelboards.
9. Disconnect switches.

3.3 ADJUSTING

A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.4 DEMONSTRATION

A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION 260572

SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH 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. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals may be in digital form.

1. Arc-flash study input data, including completed computer program input data sheets.
2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.

    a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Arc-Flash Study Software Developer and Arc-Flash Study Specialist.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.

B. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 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 unacceptable.

B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Coordination-Study Specialist Qualifications: An organization experienced in the application of computer software used for studies having performed successful studies of similar magnitude on electrical distribution systems using similar devices and being in this type service/business for at least 10 years.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Computer Software Developers: Subject to compliance with requirements, provide computer software programs developed by one of the following:

1. CYME International, Inc.

2. EDSA Micro Corporation.
3. Electrical Systems Analysis, Inc.
4. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output: As specified in "Short Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

G. Arc-Flash Study Output:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

H. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Working distance.
6. Incident energy.
7. Hazard risk category.
8. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Flash protection boundary.
4. Hazard risk category.
5. Incident energy.
6. Working distance.
7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies:

1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."
2. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

C. Calculate maximum and minimum contributions of fault-current size.

1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.

1. Verify completeness of data supplied on the one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to the attention of Architect.

2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other 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. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
15. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.4 LABELING

A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:

1. Motor-control center.
2. Low-voltage switchboard.
3. Switchgear.
4. Medium-voltage switch.
5. Control panel.

3.5 APPLICATION OF WARNING LABELS

A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.6 DEMONSTRATION

A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 260574

SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

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 commissioning process requirements for the following MEP systems, assemblies, and equipment:

1. Electrical lighting and lighting controls.

B. Related Requirements:

1. Section 019113 "General Commissioning Requirements" for general commissioning process requirements and Commissioning Coordinator responsibilities.

1.3 DEFINITIONS

A. Refer to Section 019113 "General Commissioning Requirements" for additional definitions and assignment of responsibilities.

1.4 CONTRACTOR’S RESPONSIBILITIES

A. Refer to Section 019113 "General Commissioning Requirements".

B. Perform commissioning tests at the direction of the CxA.

C. Attend construction phase controls coordination meeting.

D. Participate in electrical systems, assemblies, equipment, and component maintenance orientation and inspection.

E. Provide information requested by the CxA for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for complete range of testing for the required test period.

G. Provide Project-specific construction checklists and commissioning process test procedures for actual electrical systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

H. Direct and coordinate commissioning testing among subcontractors, suppliers, and vendors.

I. Verify testing and adjusting of Work are complete.

J. Provide test data, inspection reports, and certificates in Systems Manual.

1.5 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:

1. Plan for delivery and review of systems manuals, and other documents and reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's pre-start and startup checklists for electrical systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, pre-start checks, and startup procedures have been completed.
5. Certificate of readiness certifying that electrical systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.

1.6 INFORMATIONAL SUBMITTALS

A. Construction Checklists: See related Sections for technical requirements, and generate construction checklists for the following:

1. Revise list of construction checklists below to suit Project. Coordinate list with appropriate related Sections' content. Below are examples of common construction checklists.

2. Electrical lighting and lighting control systems.

B. Certificates of readiness.

C. Certificates of completion of installation, pre-start, and startup activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Refer to Section 019113 "General Commissioning Requirements".

3.2 SYSTEMS READINESS CHECKLISTS

A. Construction Checklists: Assist CxA in the preparation of detailed Systems Readiness checklists for systems, subsystems, equipment, and components.

1. Contributors to the development of checklists shall include, but are not limited to:
    a. Systems and equipment installers.
    b. Electrical and lighting technicians.
    c. Lighting controls installers.

B. Contractor shall conduct Systems Readiness Testing to document compliance with installation and Systems Readiness checklists prepared by Commissioning Authority for Division-26 items.

C. Refer to Section 019113 "General Commissioning Requirements" for issues relating to Systems Readiness checklists and testing, description of process, details on non-conformance issues relating to pre-functional checklists and test.

D. Contractor shall participate in Pre-Functional testing activities to document electrical work associated with mechanical and plumbing systems.

3.3 SYSTEM START-UP

A. Contractor is solely responsible for system start-up. CxA may, at his discretion, witness start up procedures, but will not perform any Functional Testing of systems until Contractor has completed start-up and resolved all operating deficiencies.

3.4 TESTING PREPARATION

A. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.

C. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, and alarm conditions).

D. Inspect and verify the position of each device and interlocks identified on checklists.

E. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

F. Testing Instrumentation: Install measuring instruments and logging devices to record test data as required.

3.5 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of automation system controllers and sensors.

C. Tests will be performed using design conditions whenever possible.

D. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the Contracting Officer and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

E. The CxA may direct that set points be altered when simulating conditions is not practical.

F. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

G. If tests cannot be completed because of a deficiency outside the scope of the electrical system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

H. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.6 FUNCTIONAL TEST PROCEDURES FOR SYSTEMS TO BE COMMISSIONED

A. General

1. The following paragraphs outline the functional test procedures for the various Div. 26 items to be commissioned. Functional testing will take place only after System Readiness checklists have been completed, equipment has been started-up, and Contractor has certified that systems are ready for functional testing.
2. All systems controlled via the Building Automation System shall have all control points and sequences tested by Controls Contractor prior to requesting testing by CX Authority.

3.7 COMMISSIONING TESTS

A. Lighting Systems:

1. Light Fixtures: Verify all lamps work without flicker.
2. Light Switches: Verify switches control lights per design
3. Lighting Controls: Verify Schedule and/or photocell controls

B. Customized system readiness checklists and function testing requirements will be released after the submittal review phase.

3.8 TRAINING AND O&M MANUALS

A. Refer to Div. 26 specifications.

END OF SECTION 260800

SECTION 26 0923 – LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Devices and associated accessories for automatic control of lighting and other loads:

1. Wallbox occupancy sensors.
2. Wired occupancy sensors.
3. Wireless occupancy/vacancy sensors.
4. Wireless daylight sensors.
5. Wired load control modules with wireless communication inputs for wireless sensors and control stations.
6. Wired dimmers and switches with wireless communication inputs.
7. Wireless control stations.

1.2 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. Coordinate the work to provide luminaires and lamps compatible with the lighting controls to be installed.
5. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing:
1. Do not install sensors and wall controls until final surface finishes are complete.

1.3 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. 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.
2. Wall Dimmers: Include derating information for ganged multiple devices.

C. Samples:

1. Wallbox Controls:
   a. Show available color and finish selections.
   b. Provide one sample(s) for each product proposed for substitution.
2. Sensors: Provide one sample(s) for each product proposed for substitution.

D. 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.

E. Project Record Documents: Record actual installed locations and settings for lighting controls.

F. Operation and Maintenance Data: Include detailed information on lighting control system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

G. Warranty: Submit sample of manufacturer's Warranty as specified in Part 1 under "WARRANTY". Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.4 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 controls, including products using wireless communication between devices.
2. Registered to ISO 9001, including in-house engineering for product design activities.
3. Provides factory direct technical support hotline available 24 hours per day, 7 days per week.
4. Qualified to supply specified products and to honor claims against product presented in accordance with warranty.

1.5 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.

1.6 FIELD CONDITIONS

A. Maintain field conditions within manufacturers required service conditions during and after installation.

1. System Requirements- *Lutron*, Unless Otherwise Indicated:
   a. Ambient Temperature:

1) Lighting Controls: Between 32 and 104 degrees F (0 and 40 degrees C).
b. Relative Humidity: Less than 90 percent, non-condensing.
c. Protect lighting controls from dust.

1.7 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Standard Warranty:

1. Manufacturer Lighting Control System Components, Except Wallbox Occupancy Sensors, Wireless Sensors, Ballasts/Drivers and Ballast Modules: One year 100 percent parts coverage, no manufacturer labor coverage.
2. Wallbox Occupancy Sensors and Wireless Sensors: Five years 100 percent parts coverage, no manufacturer labor coverage.
3. Ballasts/Drivers and Ballast Modules: Three years 100 percent parts coverage, no manufacturer labor coverage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: *Lutron Electronics Company, Inc; www.lutron.com*.

B. Other Acceptable Manufacturers:

1. Wattstopper
2. Sensor Switch
3. Products by listed manufacturers are subject to compliance with specified requirements and 10 day prior approval by Architect

C. Substitutions:

1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by Architect 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. Any proposed substitutions to be reviewed by Architect/Engineer. 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.

D. Source Limitations: Where possible, furnish products produced by a single manufacturer and obtained from a single supplier.

2.2 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL) as suitable for the purpose indicated.

B. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, programming, etc. as necessary for a complete operating system that provides the control intent indicated.

C. 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.

D. Electrostatic Discharge Tolerance: Design and test equipment to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2.

E. Power Failure Recovery: When power is interrupted for periods up to 10 years and subsequently restored, lights to automatically return to same levels (dimmed setting, full on, or full off) as prior to power interruption.

F. Wireless Devices:

1. Capable of diagnosing system communications.
2. Capable of having addresses automatically assigned to them.
3. Receives signals from other wireless devices and provides feedback to user.
4. Capable of determining which devices have been addressed.
5. RF Frequency: 434 MHz; operate in FCC governed frequency spectrum for periodic operation; continuous transmission spectrum is not permitted.
6. RF Range: 60 feet (18 m) line-of-sight or 30 feet (9 m) through typical construction materials between RF transmitting devices and compatible RF receiving devices.
7. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of CFR, Title 47, Part 15, for Class B application.

G. Device Finishes:

1. Wallbox Controls:
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 per ASTM E308.
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.

2.3 WALLBOX OCCUPANCY SENSORS

A. General Requirements:

1. Passive Infrared Sensing:
   a. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
   b. 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.

2. Ultrasonic Sensing: Utilize an operating frequency of 32 kHz or 40 kHz, crystal-controlled to operate within plus/minus 0.005 percent tolerance.
3. Dual Technology Sensing: Passive infrared and ultrasonic sensing coupled with technology for sensing very fine motions; Lutron XCT Technology. Signal processing technology detects fine-motion passive infrared (PIR) and ultrasonic signals without the need to change the sensor's sensitivity threshold.

B. Wall Switch Occupancy/Vacancy Sensors; Lutron Maestro Series:

1. General Requirements:
   a. 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.
   b. Switches at point of minimum energy to maximize relay life, actively adapting to variations in relay timing.
   c. Suitable for incandescent, halogen, electronic low-voltage, magnetic low-voltage, compact fluorescent, LED, magnetic fluorescent, electronic fluorescent, and fan loads.
2. Passive Infrared Wall Switch Combination Occupancy/Vacancy Sensors:
   a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
   b. Adjustable sensitivity (high, low presets).
   c. Selectable option to enable low light feature (automatic-on when ambient light is below threshold). Ambient light threshold to be adaptive utilizing occupant feedback; Lutron Smart Ambient Light Detection.
   d. Selectable option to inhibit automatic turn-on of lights after manual-off operation while room is occupied for applications such as presentation viewing in conference rooms and classrooms; when room is vacated, returns to normal automatic-on operation after time delay period.
   e. Product(s):
      1) Passive Infrared Wall Switch Occupancy/Vacancy Sensor*; Lutron Maestro Series, Model MS-OPS6M2-DV*: 6 A lighting (120-277 V), 3 A fan (120 V); coverage of 900 square feet (81 sq m) with mounting height of 4 feet (1.2 m); 180 degree field of view; multi-location capability using standard 3-way or companion switch (up to nine companion switches may be connected).
      2) Passive Infrared Wall Switch Occupancy/Vacancy Sensor*; Lutron Maestro Series, Model MS-OPS6M2N-DV*: 6 A lighting (120-277 V), 3 A fan (120 V); neutral required; coverage of 900 square feet (81 sq m) with mounting height of 4 feet (1.2 m); 180 degree field of view; multi-location capability using standard 3-way or companion switch (up to nine companion switches may be connected).
      3) Passive Infrared Wall Switch Occupancy/Vacancy Sensor*; Lutron Maestro Series, Model MS-OPS6M2U-DV*: 6 A lighting (120-277 V), 3 A fan (120 V); convertible to require connection to either neutral or ground; coverage of 900 square feet (81 sq m) with mounting height of 4 feet (1.2 m); 180 degree field of view; multi-location capability using standard 3-way or companion switch (up to nine companion switches may be connected).
      4) Passive Infrared Wall Switch Occupancy/Vacancy Sensor*; Lutron Maestro Series, Model UMS-OPS6M2-DV*: BAA (Buy American Act)

Compliant; 6 A lighting (120-277 V), 3 A fan (120 V); neutral required; coverage of 900 square feet (81 sq m) with mounting height of 4 feet (1.2 m); 180 degree field of view; multi-location capability using companion switch (up to nine companion switches may be connected); minimum load requirement.

2.4 WIRED OCCUPANCY SENSORS

A. General Requirements:

1. Connects directly to compatible ballasts and modules without the need of a power pack or other interface.
2. 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.
3. Accommodates all conditions of space utilization and all irregular work hours and habits.
4. Comply with UL 94.
5. Self-Adaptive: Continually adjusts sensitivity and timing to ensure optimal lighting control for any use of the space.
6. Furnished with field-adjustable controls for time delay and sensitivity to override any adaptive features.
7. Power Failure Memory: Settings and learned parameters to be saved in non-volatile memory and not lost should power be interrupted and subsequently restored.
8. Furnished with all necessary mounting hardware and instructions.
9. Class 2 devices.
10. Ceiling-Mounted Sensors: Indicate viewing directions on mounting bracket.
11. Wall-Mounted Sensors: Provide swivel-mount base.
12. Color: White.

B. Wired Dual Technology Sensors:

1. Passive Infrared Sensing: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
2. Ultrasonic Sensing: Utilize an operating frequency of 32 kHz or 40 kHz, crystal-controlled to operate within plus/minus 0.005 percent tolerance.
3. Ceiling-Mounted Sensors: Provide customizable mask to block off unwanted viewing areas.
4. 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 Omit the choice in the following paragraph if only models with integral photocell will be used.
5. Integral Photocell: Provide an integral photocell with adjustable sensitivity to prevent lights from turning on when there is sufficient natural lightIf more than one model is required, the optional choice can be used to assign type designations. If more than one model is required, the optional choice can be used to assign type designations. Make sure that designations indicated on the drawings are consistent with those specified here. Visit www.lutron.com for data sheets and other information.

2.5 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.

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 for drop ceilings to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method to be designed for easy, damage-free removal.
   j. Sensor lens to illuminate during test mode when motion is detected to allow installer to place sensor in ideal location and 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.
   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* 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;* 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 (1.8 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* 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 (1.8 to 2.4 m); 90 degree field of view.

4) Hallway Occupancy/Vacancy Sensor*; << Lutron Radio Powr Savr Series, Model LFR2-OHLB-P-WH;* Major motion coverage of up to 150 feet (45.7 m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); narrow field of view..

2.6 LOAD CONTROL MODULES FOR WIRELESS SENSORS AND CONTROL STATIONS

A. Provide wireless load control modules as indicated or as required to control the loads as indicated.

B. Junction Box-Mounted Modules:

1. Communicates via radio frequency with up to nine compatible wireless control stations, up to six occupancy/vacancy sensors, and one daylight sensor.
2. Plenum rated.
3. Dimming Modules:
   a. Product(s):
      1) 5 A dimming module with 0-10V control; << Lutron PowPak Dimming Module Model RMJ-5T-DV-B; IEC 60929 is a standard for electronic fluorescent ballasts, and is used by other lighting equipment controlled by low voltage signals including LED drivers and low voltage controlled neon. It defines specific methods for 0-10V, pulse width modulation (PWM), and Digitally Addressable Lighting Interface (DALI).
   b. Single low voltage dimming module with Class 1 or Class 2 isolated 0-10V output signal conforming to IEC 60929 Annex E.2; source or sink automatically configures.
   c. Configurable high- and low-end trim.
   d. Relay: Rated for 0-10 V ballasts, LED drivers, or fixtures that conform with NEMA 410.
4. Relay Modules:
   a. Product(s):

1) 16 A relay module, without contact closure output*; Lutron PowPak Relay Module Model RMJ-16R-DV-B;* 16 A relay module, with contact closure output*; Lutron PowPak Relay Module Model RMJ-16RCCO1-DV-B;* 5 A relay module, without contact closure output*; Lutron PowPak Relay Module Model RMJ-5R-DV-B*.

b. Relay:

1) Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
2) Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
3) Fully rated output continuous duty for inductive, capacitive, and resistive

2.7 WIRELESS CONTROL STATIONS

A. Products

1. 2-Button Control;<*Lutron Pico Wireless Control Model PJ2-2B;*
   a. Button Marking *on drawings*
2. 2-Button Control with Night Light; *Lutron Pico Wireless Control Model PJN-2B.*
3. Wallbox Adapter; Lutron Model PICO-WBX-ADAPT.

B. Communicates directly to compatible RF receiving devices through use of a radio frequency communications link.

C. Does not require external power packs, power or communication wiring.

D. Allows for easy reprogramming without replacing unit.

E. Button Programming:

1. Single action.
2. Toggle action.

F. Includes LED to indicate button press or programming mode status.

G. Mounting:

1. Capable of being mounted with a table stand or directly to a wall under a faceplate.
2. Faceplates: Provide concealed mounting hardware.

H. Power: Battery-operated with minimum ten-year battery life (3-year battery life for night light models).

I. Finish: <<*As specified for wall controls in "Device Finishes" under LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS article above;*

2.8 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.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that ratings and configurations of devices are consistent with the indicated requirements.
C. Verify that mounting surfaces are ready to receive devices.
D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130

B. Coordinate locations of outlet boxes provided under Section *26 0537* as required for installation of devices provided under this section.

C. Where multiple devices are installed at the same location and at the same mounting height, gang devices together under a common wall plate.

D. Install products in accordance with manufacturer's instructions.

E. Install permanent barrier between ganged devices when voltage between adjacent devices exceeds 300 V.

F. Install wall dimmers to achieve full rating specified after derating for ganging as instructed by manufacturer.

G. Sensor Locations:

1. 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.

H. 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.

I. 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.

J. Identify devices<< *in accordance with Section 26 0553*>>.

3.4 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

3.5 ADJUSTING

A. Sensor Fine-Tuning: Contractor to provide fine-tuning of sensor calibration.

3.6 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.7 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: Demonstrate proper operation of lighting control devices to Engineer; or owner, and correct deficiencies or make adjustments as directed.

3.8 PROTECTION

A. Protect installed products from subsequent construction operations.

END OF SECTION 260923

SECTION 260943.23 - RELAY-BASED LIGHTING CONTROLS

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: Networked lighting control panels using control-voltage relays for switching and that are interoperable with BMS system for HVAC.

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 control modules, power distribution components, relays, manual switches and plates, and conductors and cables.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each relay panel 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 wiring partition configuration, current, and voltage ratings.
4. Short-circuit current rating of relays.
5. Include diagrams for power, signal, and control wiring.
6. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.

1. Show interconnecting signal and control wiring, and interface devices that prove compatibility of inputs and outputs.
2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices comply with interoperability requirements of the network protocol.

B. Qualification Data: For testing agency.

C. Field quality-control reports.

D. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.

E. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

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. Lighting Control Relays: Equal to percent of amount installed for each size indicat**ed**, but no fewer than.

1.7 QUALITY ASSURANCE

A. Manufacturer shall be regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Source Limitations: Obtain lighting control module and power distribution components through one source from a 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.

E. Control wiring shall be in accordance with the NEC requirements for Class 2 remote control systems, Article 725 and manufacturer specification.

F. A licensed electrician shall functionally test each system component after installation, verify proper operation and confirm that all relay panel and switch wiring conform to the wiring documentation.

G. Comply with NEC and all local and state codes as applicable to electrical wiring work.

H. Lighting control panels shall be UL 916 Listed. LCPs controlling emergency circuits shall be listed to UL 924. Emergency source circuits controlled in normal operation by a relay panel shall fully comply with NEC 700-9(b). Electrical contractor is responsible for verifying compliance.

I. The lighting control system shall be listed, approved and comply as required with all national, state and local energy codes to include but not limited to California Title 24 and ASHRAE 90.1-2004.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Handle and prepare panels for installation according to manufacturer’s recommendations..

1.9 COORDINATION

A. Coordinate lighting control components to form an integrated interconnection of compatible components.

1. Match components and interconnections for optimum performance of lighting control functions.
2. Coordinate lighting controls with that in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of software input/output to execute switching commands.
Failure of modular relays to operate under manual or software commands
b. Available warranties and warranty periods with manufacturers listed in Part 2 article.

2. Warranty Period: Two years from date of Substantial Completion. .
3. Extended Warranty Period for Electrically Held Relays: 8 years from date of Substantial Completion.

SECTION 260943.23 - RELAY-BASED LIGHTING CONTROLS

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Input signal from field-mounted manual switches, or digital signal sources, shall open or close one or more lighting control relays in the lighting control panels. Any combination of inputs shall be programmable to any number of control relays.

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 47 CFR, Subparts A and B, for Class A digital devices.

D. Comply with UL 916.

2.2 LIGHTING CONTROL RELAY PANELS

A. MANUFACTURERS

1. Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Lighting Control & Design, Inc.
b. Lutron
c. Hubbell
d. Cooper lighting controls
e. Wattstoper

B. Description: Standalone lighting control panel using mechanically latched relays to control lighting and appliances.

C. Lighting Control Panel:

1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.

D. Control Unit: Contain the power supply and electronic control for operating and monitoring individual relays.

1. Timing Unit:

a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
c. Four independent schedules, each having 24 time periods.
d. Schedule periods settable to the minute.
e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
f. 10 special date periods.

2. Sequencing Control with Override:

a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches.
b. Override control shall allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
c. Override control "blink warning" shall warn occupants approximately five minutes before actuating the off sequence.

3. Nonvolatile memory shall retain all setup configurations. After a power failure, the controller shall automatically reboot and return to normal system operation, including accurate time of day and date.

E. Relays: Electrically operated, mechanically held single-pole switch, rated at 20 A at 120-277V. Short-circuit current rating shall be not less than 14 kA.

F. Power Supply: NFPA 70, Class 2, sized for connected equipment, plus 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, low-voltage inputs, field-installed occupancy sensors, and photo sensors.

G. Operator Interface:

1. Integral alphanumeric keypad and digital display, and intuitive drop-down menus to assist in programming.
2. Log and display relay on-time.
3. Connect relays to one or more time and sequencing schemes.

H. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

I. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

2.3 PANEL INSTALLATION

A. Comply with NECA 1.

B. Install panels and accessories according to NECA 407.

C. Mount top of trim 90 inches above finished floor unless otherwise indicated.

D. Mount panel cabinet plumb and rigid without distortion of box.

E. Install filler plates in unused spaces.

2.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

C. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC or typewriter to create directory; handwritten directories are unacceptable.

D. Lighting Control Panel Nameplates: Label each panel with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

2.5 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 test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

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.

D. Acceptance Testing Preparation:

1. Test continuity of each circuit.

E. Lighting control panel will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies lighting control panels and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

2.6 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.
2. Confirm correct communications wiring, initiate communications between panels, and program the lighting control system according to approved configuration schedules, time-of-day schedules, and input override assignments.

2.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the control unit and operator interface.

END OF SECTION 260943.23

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. Section Includes: Distribution and buck-boost dry-type transformers rated 600 V and less, with capacities up to 1500 kVA

B. Copper-wound transformers exceeding US Department of Energy 2016 mandated minimum efficiency. These transformers shall be UL listed to feed a K-7 electronic equipment load profile and be optimized to minimize opeating cost under light loading.

B. Compliance with full specification is required

C. Basic compliance with NEMA TP1/EPACT2005, NEMA Premium, CEE Tier 1, or CSL3 is not sufficient to meet this specification due to the following:

1. Efficiencies must exceed the US DOE 2016 minimum requirement
2. No load losses must comply with those defined in this specification
3. Efficiency at low load and under nonlinear K-7 load must meet the minimum requirements of this specification
4. K-7 listing per UL 1561 is required
5. Comprehensive testing under linear and nonlinear loading is required to verify specified performance
6. Performance submittals are required

D. Load Mix: Transformer shall be UL 1561 Listed to feed a mix of equipment load profiles suchas computers without de-rating or significant degradation of efficiency.

1.3 REFERENCES

A. US Department of Energy, 10 CFR Part 431, April 18, 2013. Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule

B. DOE Test Method for Measuring the Energy Consumption of Distribution Transformers under Appendix A to Subpart K of 10 CFR part 431.

C. ANSI/NEMA ST 20 - Dry Type Transformers for General Applications.

D. NEMA Premium Efficiency Transformers Program

E. Consortium for Energy Efficiency (CEE): Specification for Low-Voltage, Dry- Type Distribution Transformers

F. EPACT 2005 - United States Energy Policy Act 2005 / NEMA TP1 - Guide for Determining Energy Efficiency for Distribution Transformers

G. ANSI/NEMA TP-2 – Standard Test Method for Measuring Energy Consumption of Distribution Transformers

H. Metering Standards:

1. Computational algorithms per IEEE Std 1459-2000
2. UL 916, UL 61010C-1 CAT III

I. IEEE C57.110-1998 – IEEE Recommended Practice for establishing transformer capability when feeding nonsinusoidal load currents

J. IEEE Std C57.12.91-1995 Standard Test Code for Dry-Type Transformers

K. IEEE-1100 – Recommended Practice for Powering and Grounding Sensitive Electronic Equipment

L. LEED – Leadership in Energy and Environmental Design, U.S. Green Building Council.

M. Seismic Qualification References: International Building Code, 2006/2009 Edition, California Building Code, 2007/2010 Edition, ASCE Standard 7, 2005 Edition to OSHPD CAN 2-1708A.5, Rev. , ICC-ES AC 156, Effective 01/01/2007, OSHPD

N. ISO 9001:2008 – International Standards Organization - Quality Management System

O. ISO 14001:2004 – International Standards Organization - Environmental Management System

P. ISO 17025 – International Standards Organization - General requirements for the competence of testing and calibration laboratories

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 each type and size of transformer.
2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

B. Certified Test Reports

1. Provide test reports certified by factory test engineer for both transformer types and each kVA used on this project documenting compliance of previously manufactured units.
2. Provide details of factory ISO compliant production nonlinear load test
3. Provide performance under nonlinear load profile typical of modern electronic equipment

4. Provide NEMA TP2 test reports

C. Shop Drawings:

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. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
3. Include diagrams for power, signal, and control wiring.

D. Qualification Data: For testing agency.

E. Source quality-control reports.

F. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.5 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering transformers that may be incorporated into the Work include the following:

1. Powersmiths International Corp Model ESAVER2016 (Non-harmonics canceling type).
2. Powersmiths International Corp. Model T10002016 (harmonics canceling type).
3. Square D NEMA Premium 30
4. Eaton corp. CSL3
5. Others as approved by Engineer prior to bidding.

B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

1.1 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units of types specified, designed for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices, except for taps.

D. Internal Coil Connections: Brazed or pressure type.

E. Enclosure: Class complies with NEMA 250 for the environment in which installed.

F. Warranty: 25 years pro-rated

G. International Standard Organization registration

1. Registration to current ISO standard is required.
2. Independent annual audits are required.
3. Product shall be manufactured in registered facility
4. ISO 9001:2000 Registered – Quality Management System
5. ISO 14001:2004 Registered – Environmental Management System

H. Low-Sound-Level Units: NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91. All units on this project to be sound level tested and meet the NEMA ST-20 levels.

I. Wall Brackets: Manufacturer's standard brackets.

1.2 GENERAL-PURPOSE DISTRIBUTION AND POWER TRANSFORMERS

A. Comply with NEMA ST 20 and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Windings: One coil per phase in primary and secondary.

D. K-Factor rating: K-7

E. Exceed minimum efficiency requirements of US Department of Energy, 10 CFR Part 431, April 18, 2013, Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule which takes effect January 1, 2016, and comply with the table of Maximum No Load Losses, efficiency requirements at 1/6 load, efficiency at 35% load per 10 CFR Part 431, and efficiency at 25% load under a K-7 load profile.

kVA	No load losses (Watts)	Efficiency @ 1/6 load (%)	Efficiency @ 35% load (%)	Efficiency at 25% load under K-7 nonlinear load
15	47	97.85%	98.28	98.00%
20	60	98.05%	98.34	98.10%
25	66	98.15%	98.41	98.15%
30	71	98.27%	98.50	98.30%
45	97	98.40%	98.66	98.40%
50	112	98.45%	98.67	98.42%
63	120	98.50%	98.75	98.48%
75	135	98.63%	98.82	98.60%
100	180	98.65%	98.88	98.65%
112.5	195	98.70%	98.92	98.70%
125	215	98.73%	98.94	98.72%
150	235	98.80%	98.99	98.80%
175	270	98.82%	99.02	98.82%
200	310	98.84%	99.05	98.84%

225	330	98.90%	99.09	98.90%
250	365	98.91%	99.10	98.92%
300	400	98.95%	99.15	99.00%
400	530	98.96%	99.20	99.02%
450	600	98.97%	99.22	99.03%
500	650	99.00%	99.25	99.05%
600	800	99.01%	99.28	99.07%
750	875	99.10%	99.32	99.10%
850	950	99.11%	99.34	99.11%
1000	1200	99.12%	99.36	99.12%

F. Enclosure: Indoor, ventilated with lockable hinged door

G. Maximum Footprint for 115 degree C rise model in a NEMA 1 enclosure:

1. 18” Wide x 17” Deep x 27” High for 15kVA.
2. 26” Wide x 18” Deep x 30” High for 20, 30, 45kVA
3. 33” Wide x 22” Deep x 40” High for 50, 63, 75, 100, 112.5kVA
4. 38” Wide x 27” Deep x 48” High for 125,150, 175, 200kVA
5. 38” Wide x 32” Deep x 52” High for 225, 250, 300kVA
6. 52” Wide x 38” Deep x 61” High for 400, 450, 500kVA
7. 64” Wide x 47” Deep x 67” High for 600, 750kVA
8. 64” Wide x 53” Deep x 67” High for 850, 1000kVA

H. Insulation Class: 185 or 220 deg C class for transformers 15 kVA or smaller; 220 deg C class for transformers larger than 15 kVA.

I. Rated Temperature Rise: 130 deg C maximum rise above 40 deg C.

J. Taps: For transformers 3 kVA and larger, full-capacity taps in high-voltage windings are as follows:

1. If all transformers have same voltage taps, select from 4 subparagraphs below. If taps vary, delete all and show on Drawings. First item is standard.
2. Taps, 3 through 25 kVA: Two 5-percent taps below rated high voltage.
3. Taps, 3 through 10 kVA: Two 5-percent taps below rated high voltage.
4. Taps, 15 through 500 kVA: Six 2.5-percent taps, 2 above and 4 below rated high voltage.

K. Electrostatic Shielding: Each winding is independently single shielded with a full-width copper electrostatic shield arranged to minimize interwinding capacitance.

1. Coil leads and terminal strips are arranged to minimize capacitive coupling between input and output connections.
2. Shield Terminal: Separate; marked "Shield" for grounding connection.
3. Capacitance: Shield limits capacitance between primary and secondary to a maximum of 33 picofarads over a frequency range of 20 Hz to 1 MHz.

4. Common-Mode Noise Attenuation: Minus 120 dB minimum, 0.5 to 1.5 kHz; minus 65 dB minimum, 1.5 to 100 kHz.
5. Normal-Mode Noise Attenuation: Minus 52 dB minimum, 1.5 to 10 kHz.

1.3 HARMONIC CANCELING TRANSFORMERS

A. Transformers designed to treat a broad spectrum of odd harmonic currents, up to the 25th harmonic frequency.

B. 3rd Harmonic Treatment: 3rd, 9th, and other zero sequence currents shall not be coupled into the primary winding.

C. Voltage Distortion: Change in voltage THD between transformer primary and secondary terminals shall be minimized.

D. Fundamental current imbalance shall be reduced on the primary side of the transformer compared to the secondary side.

E. Exceed minimum efficiency requirements of US Department of Energy, 10 CFR Part 431, April 18, 2013, Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule which takes effect January 1, 2016, and comply with the table of Maximum No Load Losses, efficiency requirements at 1/6 load, efficiency at 35% load per 10 CFR Part 431, and efficiency at 50% load under a K-7 load profile.

kVA	No load losses (Watts)	Efficiency @ 1/6 load (%)	Efficiency @ 35% load (%)	Efficiency at 50% load under K-9 nonlinear load
15	52	97.80%	98.28%	97.75%
20	66	97.95%	98.34%	97.80%
25	73	98.00%	98.41%	97.85%
30	78	98.20%	98.50%	97.88%
45	107	98.30%	98.66%	97.95%
50	123	98.35%	98.67%	97.98%
63	132	98.40%	98.75%	98.00%
75	149	98.50%	98.82%	98.10%
100	198	98.57%	98.88%	98.30%
112.5	215	98.60%	98.92%	98.35%
125	237	98.65%	98.94%	98.40%
150	259	98.70%	98.99%	98.47%
175	297	98.72%	99.02%	98.50%
200	341	98.75%	99.05%	98.55%
225	363	98.80%	99.09%	98.60%
250	402	98.83%	99.10%	98.63%
300	440	98.88%	99.15%	98.70%
400	583	98.90%	99.20%	98.73%

450	660	98.92%	99.22%	98.75%
500	715	98.94%	99.25%	98.77%
600	880	98.95%	99.28%	98.79%
750	963	98.96%	99.32%	98.84%
850	1045	98.98%	99.34%	98.96%
1000	1320	99.00%	99.36%	98.90%

F. Enclosure: Indoor, ventilated with lockable hinged door

G. Maximum Footprint for 115 degree C rise model in a NEMA 1 enclosure:

1. 18” Wide x 17” Deep x 27” High for 15kVA.
2. 26” Wide x 18” Deep x 30” High for 20, 30, 45kVA
3. 33” Wide x 22” Deep x 40” High for 50, 63, 75, 100, 112.5kVA
4. 38” Wide x 27” Deep x 48” High for 125,150, 175, 200kVA
5. 38” Wide x 32” Deep x 52” High for 225, 250, 300kVA
6. 52” Wide x 38” Deep x 61” High for 400, 450, 500kVA
7. 64” Wide x 47” Deep x 67” High for 600, 750kVA
8. 64” Wide x 53” Deep x 67” High for 850, 1000kVA

H. Insulation Class: 185 or 220 deg C class for transformers 15 kVA or smaller; 220 deg C class for transformers larger than 15 kVA.

I. Rated Temperature Rise: 115 deg C maximum rise above 40 deg C.

J. Taps: For transformers 3 kVA and larger, full-capacity taps in high-voltage windings are as follows:

K. Taps, 15 through 500 kVA: Four 2.5-percent taps, 2 above and 2 below rated high voltage.

L. Electrostatic Shielding: Each winding is independently single shielded with a full-width copper electrostatic shield arranged to minimize interwinding capacitance.

M. Coil leads and terminal strips are arranged to minimize capacitive coupling between input and output connections.

1. Shield Terminal: Separate; marked "Shield" for grounding connection.
2. Capacitance: Shield limits capacitance between primary and secondary to a maximum of 33 picofarads over a frequency range of 20 Hz to 1 MHz
3. Common-Mode Noise Attenuation: Minus 120 dB minimum, 0.5 to 1.5 kHz; minus 65 dB minimum, 1.5 to 100 kHz.
4. Normal-Mode Noise Attenuation: Minus 52 dB minimum, 1.5 to 10 kHz.

1.4 BUCK-BOOST TRANSFORMERS

A. Description: Self-cooled, two-winding dry type, rated for continuous duty and with wiring terminals suitable for connection as autotransformer. Transformers shall be listed and labeled as complying with UL 506 or UL 1561.

1. Standard impedance at 60Hz: 2 percent to 5 percent (up to 10 kVA), 4 percent to 6.5 percent (above 10 kVA).
2. Nameplate Rating: Linear load, 60Hz.
3. Insulation Class: 220 deg C system.
4. Temperature Rise: 80deg C.
5. Core Construction: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
6. Coil Conductors: Continuous aluminum windings, with terminations brazed, welded, or bolted.
7. Coil Impregnation: Vacuum impregnated with polyester resin.
8. Sound Level: Not exceeding values listed above for distribution transformers.
9. Enclosure: Ventilated, NEMA 250, Type 3R.
10. Terminations: Transformer coils shall terminate in mounting pads. Mounting lugs shall be provided on all units up to and including 270 A ratings.
11. Antivibration pads or isolators shall be used between the transformer core and coil and the enclosure.
12. Ground core and coil assembly to enclosure with a flexible copper grounding strap or equivalent.
13. Mounting:

    a. Ventilated Units up to 750 lb.: Suitable for wall, floor, or ceiling mounting (drip plate required).
    b. Ventilated Units over 750 lb.: Suitable for floor mounting only.
    c. Encapsulated Units up to 285 lb.: Suitable for wall or floor mounting.
    d. Encapsulated Units over 285 lb.: Suitable for floor mounting only.

B. Enclosure: Ventilated, NEMA 250, Type 3R.

1. Finish Color: NSF/ANSI 49 gray.

1.5 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution and buck-boost transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

1.6 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.

1. Resistance measurements of all windings at the rated voltage connections and at all tap connections.
2. Ratio tests at the rated voltage connections and at all tap connections.

3. Phase relation and polarity tests at the rated voltage connections.
4. No load losses, and excitation current and rated voltage at the rated voltage connections.
5. Impedance and load losses at rated current and rated frequency at the rated voltage connections.
6. Applied and induced tensile tests.
7. Regulation and efficiency at rated load and voltage.
8. Insulation Resistance Tests:

    a. High-voltage to ground.
    b. Low-voltage to ground.
    c. High-voltage to low-voltage.

9. Temperature tests.

B. Factory Sound-Level Tests: Conduct prototype sound-level tests on production-line products.

PART 2 - EXECUTION

2.1 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 Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

2.2 INSTALLATION

A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.

B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.

C. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" or [Section 033053 "Miscellaneous Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

D. Secure transformer to concrete base according to manufacturer's written instructions.

E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.

F. Remove shipping bolts, blocking, and wedges.

2.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. 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-486B.

D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

2.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. 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.

C. Efficiency & Harmonic Performance Validation: To insure that the products shipped to the job site meet this specification, provide on-site revenue class accurate efficiency and harmonic measurements of transformers once installed and operating at customer’s site. Data shall be collected from primary and secondary sides of the transformer simultaneously on a synchronized cycle-by-cycle basis. The use of two discrete meters that are not synchronized is not acceptable. Sampling shall be of 10% of transformers on the project once installed and operating, as selected by customer. Submit a detailed report to the project engineer.

D. 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.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS for dry-type, air-cooled, low-voltage transformers. Certify compliance with test parameters.

F. Remove and replace units that do not pass tests or inspections and retest as specified above.

G. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Perform two follow-up infrared scans of transformers, one at four months and the other at 11 months after Substantial Completion.
3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

H. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

2.5 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 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

2.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262200

SECTION 262413 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. Disconnecting and overcurrent protective devices.
3. Instrumentation.
4. Control power.
5. Accessory components and features.
6. Identification.
7. Mimic bus.

1.3 ACTION SUBMITTALS

A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.

1. 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. Include evidence of NRTL listing for series rating of installed devices.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. 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.
9. Include diagram and details of proposed mimic bus.
10. 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. 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.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Routine maintenance requirements for switchboards and all installed components.
b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
c. 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 less 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: Certified by NETA to supervise on-site testing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards.

C. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.9 FIELD 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 weather tight, wet work in spaces is complete and dry, work above switchboards is complete, and 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 110 deg F.
    b. Altitude: Not exceeding 6600 feet.

C. Unusual Service Conditions: NEMA PB 2, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

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 Architect/Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Architect/Owner written permission.
4. 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 with concrete.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SWITCHBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D Co.
2. Eaton Corporation.
3. Siemens

B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. 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.

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 2.

F. Comply with NFPA 70.

G. Comply with UL 891.

H. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Panel mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

I. Front- and Side-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.
2. Branch Devices: Panel mounted.
3. Section Alignment: Front and Rear aligned.

J. Front- and Rear-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.
2. Branch Devices: Panel and fixed, individually mounted.
3. Sections front and rear aligned.

K. Nominal System Voltage: as noted on drawings.

L. Main-Bus Continuous: as noted on drawings.

M. Indoor Enclosures: Steel, NEMA 250, Type 1.

N. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

O. Outdoor Enclosures: Type 3R, painted stainless steel.

1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.
2. Enclosure: Downward, rearward sloping roof; bolt-on rear covers for each section, with provisions for padlocking.

P. Barriers: Between adjacent switchboard sections.

Q. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.

R. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.

S. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

T. Removable, Hinged Rear Doors and Compartment Covers: Secured by captive thumb screws, for access to rear interior of switchboard.

U. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

V. 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.

W. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated.
3. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
4. Copper feeder circuit-breaker line connections.
5. Tin-plated aluminum feeder circuit-breaker line connections.
6. 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.
7. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
8. 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.
9. Disconnect Links:

    a. Isolate neutral bus from incoming neutral conductors.
    b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
10. 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.
11. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

X. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

Y. 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 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. 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. 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 adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
4. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).

2.3 INSTRUMENTATION

A. Instrument Transformers: NEMA EI 21.1, and the following:

1. Potential Transformers: NEMA EI 21.1; 120 V, 60 Hz, [single] [tapped] [double] secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
2. Current Transformers: NEMA EI 21.1; 5 A, 60 Hz, secondary; [wound] [bushing] [bar or window] type; [single] [double] secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
4. 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: 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 0.5 percent.
    b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.
    c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
    d. Megawatts: Plus or minus 1 percent.
    e. Megavars: Plus or minus 1 percent.
    f. Power Factor: Plus or minus 1 percent.
    g. Frequency: Plus or minus 0.1 percent.
    h. Accumulated Energy, Megawatt Hours: Plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.
    i. Megawatt Demand: Plus or minus 1 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.

C. Instrument Switches: Rotary type with off position.

1. Voltmeter Switches: Permit reading of all phase-to-phase voltages and, where a neutral is indicated, phase-to-neutral voltages.
2. Ammeter Switches: Permit reading of current in each phase and maintain current-transformer secondaries in a closed-circuit condition at all times.

2.4 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

B. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

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.

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- 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- 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.

1. Lift or move switchboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
3. Protect from moisture, dust, dirt, and debris during storage and installation.
4. Install temporary heating during storage per manufacturer's instructions.

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 or that affect the performance of the equipment.

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 nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches above concrete base after switchboard is anchored in place.
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 concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to switchboards.

6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.

D. 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.

E. Install filler plates in unused spaces of panel-mounted sections.

F. Install overcurrent protective devices, surge protection devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

G. Install spare-fuse cabinet.

H. Comply with NECA 1.

3.3 CONNECTIONS

A. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.

B. Support and secure conductors within the switchboard according to NFPA 70.

C. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "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 Section 260553 "Identification for Electrical Systems."

3.5 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.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Acceptance Testing:

    a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
    b. Test continuity of each circuit.

2. Test ground-fault protection of equipment for service equipment per NFPA 70.
3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
5. 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.

6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Switchboard will be considered defective if it does not pass tests and inspections.

D. 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 Section 260573 "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.

1.3 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. 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.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.

3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for series rating of installed devices.
7. Include evidence of NRTL listing for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.
11. 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. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

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 Section 017823 "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 GFEP Types: Two spares for each panelboard.
3. 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.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

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 FIELD 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 to plus 104 deg F.
    b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

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 Architect no fewer than 7 days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Architect's, Construction Manager's and Owner's written permission.
3. Comply with NFPA 70E.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D Co.
2. Eaton Corporation.
3. Siemens

2.2 PANELBOARDS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

B. 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.

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 NEMA PB 1.

E. Comply with NFPA 70.

F. Enclosures: Flush and Surface-mounted, dead-front 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 or 4XSS (as noted on plans).
c. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
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 5 or Type 12 (as noted on plans).

2. Height: 84 inches maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
7. Finishes:

a. Panels and Trim: 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: Same finish as panels and trim.

G. Incoming Mains:

1. Location: coordinated on the field by the electrical contractor.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

H. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

a. Plating shall run entire length of bus.
b. Bus shall be fully rated the entire length.

2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
7. Split Bus: Vertical buses divided into individual vertical sections.

I. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.

9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

J. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

K. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: Ten percent.

L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.3 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1 or Type 2 (as noted on plans).

2.4 POWER PANELBOARDS

A. Panelboards: NEMA PB 1, distribution type.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

C. Mains: Circuit breaker or Lugs only (as noted on plans).

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

B. Mains: Circuit breaker or Lugs only (as noted on plans).

C. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

E. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.6 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

    a. Inverse time-current element for low-level overloads.
    b. Instantaneous magnetic trip element for short circuits.
    c. 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:

    a. RMS sensing.
    b. Field-replaceable rating plug or electronic trip.
    c. Digital display of settings, trip targets, and indicated metering displays.
    d. Multi-button keypad to access programmable functions and monitored data.
    e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    f. Integral test jack for connection to portable test set or laptop computer.
    g. Field-Adjustable Settings:

        1) Instantaneous trip.
        2) Long- and short-time pickup levels.
        3) Long and short time adjustments.
        4) Ground-fault pickup level, time delay, and I squared T response.
4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
5. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
6. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
7. Subfeed Circuit Breakers: Vertically mounted.
8. MCCB Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Breaker handle indicates tripped status.
    c. UL listed for reverse connection without restrictive line or load ratings.

d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional with field-adjustable 0.1- to 0.6-second] time delay.
i. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
j. Auxiliary Contacts: Two, SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
k. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
l. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
m. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
n. Multipole units enclosed in a factory assembled to operate as a single unit.
o. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
p. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.7 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in metal frame with transparent protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.8 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. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NECA 407 and NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

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. Comply with NECA 1.

C. Install panelboards and accessories according to NECA 407 and NEMA PB 1.1.

D. Equipment Mounting:

1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete." and or Section 033053 "Miscellaneous Cast-in-Place Concrete."
2. Attach panelboard to the vertical finished or structural surface behind the panelboard.

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Mount top of trim 90 inches above finished floor unless otherwise indicated.

G. Mount panelboard cabinet plumb and rigid without distortion of box.

H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

I. Mounting panelboards with space behind is recommended for damp, wet, or dirty locations. The steel slotted supports in the following paragraph provide an even mounting surface and the recommended space behind to prevent moisture or dirt collection.

J. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.

K. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.
2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

M. Install filler plates in unused spaces.

N. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

O. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "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. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 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.

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. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. 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.

E. Panelboards will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 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 Section 260573 "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. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, 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. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Receptacles with integral surge-suppression units.
4. Isolated-ground receptacles.
5. USB charger electrical outlet
6. Tamper-resistant receptacles.
7. Weather-resistant receptacles.
8. Snap switches and wall-box dimmers.
9. Wall-switch and exterior occupancy sensors.
10. Pendant cord-connector devices.
11. Cord and plug sets.
12. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

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 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

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. Service/Power Poles: One for every 10, but no fewer than one.
2. Floor Service-Outlet Assemblies: One for every 10 but no fewer than one.
3. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.

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. 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).

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, 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 NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

B. Hospital-Grade, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.

C. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. 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, UL 498 Supplement sd, and FS W-C-596.

1. Description: Labeled shall comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

C. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:

D. Hospital-Grade, Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

2.5 TVSS RECEPTACLES

A. General Description: Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 1449, and FS W-C-596, with integral TVSS in line to ground, line to neutral, and neutral to ground.

1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 V and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
2. Active TVSS Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."

B. Duplex TVSS Convenience Receptacles:

1. Description: Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.

C. Isolated-Ground, Duplex Convenience Receptacles:

1. Description:

a. Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.
b. 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.

2.6 USB CHARGER RECEPTACLES

A. General Description: Comply with NEMA WD 1, NEMA WD 6. Comparable with iPad, iPhone, Tablets, Mobile Phone, Smartphones, Digital Cameras.

1. Components: 20A tamper resistant receptacle, two 5 volt DC, 2100 mA USB ports (2.0 and 3.0), 10.5 watts.
2. 2.1-amp USB type A receptacles, back and side wire terminals
3. Legrand TMBUSWCC6

B. Hospital-Grade, Duplex Convenience Receptacles: Comply with UL 498 Supplement sd.

1. Description: Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.
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. Comply with NFPA 70.

C. Isolated-Ground, Hospital-Grade, Duplex Convenience Receptacles:

1. Description:

a. Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.
b. Comply with UL 498 Supplement sd.

c. 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 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

2.8 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.

B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:

1. Description:

a. Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
b. 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.

2.9 PENDANT CORD-CONNECTOR DEVICES

A. Description:

1. Matching, locking-type plug and receptacle body connector.
2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
4. 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.

2.10 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.

3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.11 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Single Pole
2. Two Pole
3. Three Way
4. Four Way

C. Pilot-Light Switches, 20 A:
1. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

D. Key-Operated Switches, 120/277 V, 20 A:
1. Description: Single pole, Corbin type 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.

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.

2.12 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. Illuminated when "off."

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.

2.13 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Tamper proof metal with head color to match plate finish.
2. Material for Finished Spaces: Type 302 stainless steel, 0.04-inch thick.
3. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp 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, flap-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plates, Rectangular, solid brass with satin finish. Select accordingly to be fully flush with the finished surface:
1. Suitable for Wood floor
2. Suitable for Carpet floor.
3. Suitable for Tile floor.

D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Blank cover with bushed cable opening.

2.15 POKE-THROUGH ASSEMBLIES

A. Description:

1. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
2. Comply with UL 514 scrub water exclusion requirements.
3. Service-Outlet Assembly: Flush type with four simplex receptacles and space for four RJ-45 jacks complying with requirements in Section 271500 "Communications Horizontal Cabling."
4. Size: Selected to fit nominal 4-inch cored holes in floor and matched to floor thickness.
5. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
6. Closure Plug: Arranged to close unused 4-inch cored openings and reestablish fire rating of floor.
7. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables that comply with requirements in Section 271500 "Communications Horizontal Cabling."

2.16 PREFABRICATED MULTIOUTLET ASSEMBLIES

A. Description:

1. Two-piece surface metal raceway, with factory-wired multioutlet harness.

2. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

B. Raceway Material: Metal, with manufacturer's standard finish.

C. Multioutlet Harness:

1. Receptacles: 15-A, 125-V, NEMA WD 6 Configuration 5-15R receptacles complying with NEMA WD 1, UL 498, and FS W-C-596.
2. Receptacle Spacing: 12 inches or as noted on plans.
3. Wiring: No. 12 AWG solid, Type THHN copper, single circuit or two circuit (as noted on plans), connecting alternating receptacles.

2.17 SERVICE POLES

A. Description:

1. 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.
2. Poles: Nominal 2.5-inch-square cross section, with height adequate to extend from floor to at least 6 inches above ceiling, and with separate channels for power wiring and voice and data communication cabling.
3. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
4. Finishes: Satin-anodized aluminum.
5. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, four-pair, Category 3 or Category 5 voice and data communication cables.
6. Power Receptacles: Two duplex, 20-A, straight-blade receptacles complying with requirements in this Section.
7. Voice and Data Communication Outlets: Blank insert with bushed cable opening (Four RJ-45 jacks)

2.18 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: Ivory or as selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. TVSS Devices: Blue.
4. Isolated-Ground Receptacles: Orange.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. 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 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 right 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 devices that have been in temporary use during construction and that 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 in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by 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, and on horizontally mounted receptacles to the right.
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.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black -filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display 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 unacceptable.
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. 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 area and 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.

D. Wiring device will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 262813 - 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 the following:

    a. Control circuits.
    b. Motor-control centers.
    c. Panelboards.
    d. Switchboards.
    e. Enclosed controllers.
    f. Enclosed switches.

2. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

    a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software and in PDF format.
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017700 "Closeout Procedures," and or **S**ection 017823 "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.
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 used on the Project. Submit in PDF format.
4. Coordination charts and tables and related data.

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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 FIELD CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.; Bussmann Div.

2. Mersen

B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

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.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

2.3 FUSE COVER

A. Fuse cover shall be BUSSMAN “SAMI”

2.4 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 with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- 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. Main Service: Class RK1, time delay, current limiting Bussman HI-CAP KRP-C.
2. Main Feeders: Class RK1, time delay.
   a. 250volts - Bussman LOW-PEAK LPN-RK dual element.

b. 600volts – Bussman LOW-PEAK LPS-RK dual element.

3. Motor Branch Circuits: Class RK1, time delay.
   a. 250volts - Bussman LOW-PEAK LPN-RK dual element.
   b. 600volts – Bussman LOW-PEAK LPS-RK dual element.
4. Large Motor Branch (601-4000 A): Class L, time delay.
5. Power Electronics Circuits: Class J, high speed.
6. Other Branch Circuits: Class RK1, time delay.
7. Control Transformer Circuits: Class CC, time delay, and control transformer duty.
8. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

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) in location shown on the Drawings or as indicated in the field by Architect.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

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. Molded-case switches.
5. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 ACTION 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. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. 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.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, 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. 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. 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.

D. Manufacturer's field service report.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "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. Submit on translucent log-log graph paper.

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. 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.

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 enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. 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.

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 NFPA 70.

1.9 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 and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

B. 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 Architect and or Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Architect's or Construction Manager's written permission.
4. Comply with NFPA 70E.

1.10 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D Co.
2. Eaton Corporation.
3. Siemens

2.2 FUSIBLE SWITCHES

A. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac (as per connected voltage), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicate**d** fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Type HD, Heavy Duty, Double Throw, 240 or 600-V ac (as per connected voltage) 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated 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 and aluminum 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. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Mechanical type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.

2.3 NONFUSIBLE SWITCHES

A. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac (as per connected voltage), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Type HD, Heavy Duty, Double Throw, 240 or 600-V ac (as per connected voltage), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, 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 and aluminum 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. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.4 SHUNT TRIP SWITCHES

A. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

B. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

C. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer/source of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

D. Accessories:

1. Oiltight key switch for key-to-test function.
2. Isolated neutral lug; 100 percent rating.
3. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
4. Form C alarm contacts that change state when switch is tripped.
5. Three-pole, double-throw, fire-safety and alarm relay; 120-V ac coil voltage.
6. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.5 MOLDED-CASE CIRCUIT BREAKERS

A. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

B. 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.

C. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

D. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

E. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

F. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

G. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

H. 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.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
7. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
8. Alarm Switch: One NC contact that operates only when circuit breaker has tripped.
9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
10. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
11. Electrical Operator: Provide remote control for on, off, and reset operations.

2.6 MOLDED-CASE SWITCHES

A. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

B. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
7. Alarm Switch: One NC contact that operates only when switch has tripped.
8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
9. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
10. Electrical Operator: Provide remote control for on, off, and reset operations.

2.7 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 OR 4XSS (as noted on drawings**)**.
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.
6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7 or Type 9 (as noted on drawings**)**.

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. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553 "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. 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. 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.

C. 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 enclosed switch and circuit breaker. 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 enclosed switch and circuit breaker 11 months after date of Substantial Completion.
    c. Instruments and Equipment: 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.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers 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 components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

END OF SECTION 262816

SECTION 262913 - ENCLOSED CONTROLLERS

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 the following enclosed controllers rated 600 V and less:

1. Full-voltage manual.
1. Full-voltage magnetic.
2. Multispeed.

B. Related Section:

1. Section 262923 "Variable-Frequency Motor Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on variable torque loads in ranges up to 200 hp.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. N.C.: Normally closed.

E. N.O.: Normally open.

F. OCPD: Overcurrent protective device.

G. SCR: Silicon-controlled rectifier.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.

1. Show tabulations of the following:

a. Each installed unit's type and details.
b. Factory-installed devices.
c. Nameplate legends.
d. Short-circuit current rating of integrated unit.
e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.
f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.

2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Field quality-control reports.

C. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for enclosed controllers and installed components.
2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
3. Manufacturer's written instructions for setting field-adjustable overload relays.
4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

1.7 MATERIALS MAINTENANCE 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. 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.
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. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.

5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

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. 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. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers.

1.10 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 and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in 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 Architect and or Construction Manager no fewer than seven days in advance of proposed interruption of electrical systems.
2. Indicate method of providing temporary utilities.
3. Do not proceed with interruption of electrical systems without Architect's and or Construction Manager's written permission.
4. Comply with NFPA 70E.

1.11 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, 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 with concrete.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D Co.
2. Siemens.
3. Eaton Corporation.

2.2 FULL-VOLTAGE CONTROLLERS

A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
1. Configuration: Non-reversing or two speed (as noted on drawings).
2. Surface mounting.
3. Red and Green pilot light.
4. Additional Nameplates: HIGH and LOW for two-speed switches.

C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
1. Configuration: Non-reversing.
2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button melting alloy type.
3. Surface mounting.
4. Red pilot light.

D. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
1. Configuration: Non-reversing.
2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current

of actual protected motor and having appropriate adjustment for duty cycle; external reset push button melting alloy type.
3. Surface] mounting.
4. Red pilot light.
5. N.C. auxiliary contact.

E. Magnetic Controllers: Full voltage, across the line, electrically held.

1. Configuration: Non-reversing.
2. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.

    a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.

3. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
4. Control Circuits: 24 V ac; obtained from integral CPT, with primary and secondary fuses, with control power source of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.

    a. CPT Spare Capacity: 100 VA.

5. Solid-State Overload Relay:

    a. Switch or dial selectable for motor running overload protection.
    b. Sensors in each phase.
    c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
    d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
    e. Analog communication module.

6. N.C. and N.O**.**, isolated overload alarm contact.
7. External overload reset push button.

F. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.

1. Fusible Disconnecting Means:

    a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
    b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

2. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
3. Nonfusible Disconnecting Means:

    a. NEMA KS 1, heavy-duty, horsepower-rated, non-fusible switch.
    b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

c. Auxiliary Contacts: N.O. /N.C., arranged to activate before switch blades open.

4. MCP Disconnecting Means:

a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
d. N.C. and N.O. alarm contact that operates only when MCP has tripped.
e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.

5. MCCB Disconnecting Means:

a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
e. N.C. and N.O. alarm contact that operates only when MCCB has tripped.

2.3 MULTISPEED MAGNETIC CONTROLLERS

A. General Requirements for Multispeed Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Multispeed Magnetic Controllers: Two speed, full voltage, across the line, electrically held.

1. Configuration: Non-reversing; two winding.
2. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.

a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.

3. Power Contacts: Totally enclosed, double break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
4. Control Circuits: 24-V ac; obtained from integral CPT, with primary and secondary fuses, with control power source of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.

a. CPT Spare Capacity: **100** VA.

5. Compelling relays shall ensure that motor will start only at low speed.

6. Accelerating timer relays shall ensure properly timed acceleration through speeds lower than that selected.
7. Decelerating timer relays shall ensure automatically timed deceleration through each speed.
8. Antiplugging timer relays shall ensure a time delay when transferring from FORWARD to REVERSE and back.
9. Solid-State Overload Relay:

    a. Switch or dial selectable for motor running overload protection.
    b. Sensors in each phase.
    c. Class 10/20 selectable] tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
    d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
    e. Analog communication module.

10. N.C. and N.O., isolated overload alarm contact.
11. External overload reset push button.

C. Combination Multispeed Magnetic Controller: Factory-assembled combination of reduced-voltage magnetic controller, OCPD, and disconnecting means.

1. Fusible Disconnecting Means:

    a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
    b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

2. Nonfusible Disconnecting Means:

    a. NEMA KS 1, heavy-duty, horsepower-rated, non-fusible switch.
    b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

3. MCP Disconnecting Means:

    a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
    b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
    d. N.C. or N.O. alarm contact that operates only when MCP has tripped.
    e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.

4. MCCB Disconnecting Means:

a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
N.C.or N.O. alarm contact that operates only when MCCB has tripped.

2.4 ENCLOSURES

A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 3R or Type 4XSS (as indicated on drawings).
3. Kitchen Areas: Type 4X, stainless steel.
4. Other Wet or Damp Indoor Locations: Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.
6. Hazardous Areas Indicated on Drawings: Type 7 or Type 9 (as indicated on drawings).

2.5 ACCESSORIES

A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy type.

a. Push Buttons: Shielded types; momentary as indicated.
b. Pilot Lights: LED types; colors as indicated; push to test.
c. Selector Switches: Rotary type.

2. Elapsed Time Meters: Heavy duty with digital readout in hours.
3. Meters: Panel type, 2-1/2-inch minimum size with 90- or 120-degree scale and plus or minus two percent accuracy. Where indicated, provide selector switches with an off position.

B. Reversible N.C./N.O. auxiliary contact(s).

C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

E. Breather and drain assemblies, to maintain interior pressure and release condensation in Type 4, Type 4X, Type 7, and Type 9 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

F. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

G. Cover gaskets for Type 1 enclosures.

H. Terminals for connecting power factor correction capacitors to the load side of overload relays.

I. Spare control wiring terminal blocks, quantity as indicated wired.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

B. Floor-Mounted Controllers: Install enclosed controllers on 4-inch nominal-thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete" and or Section 033053 "Miscellaneous Cast-in-Place Concrete."

1. 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.
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 supported equipment.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in each fusible-switch enclosed controller.

E. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."

F. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

G. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

H. Install power factor correction capacitors. Connect to the load side of overload relays. If connected to the load side of overload relays, adjust overload heater sizes to accommodate the reduced motor full-load currents.

I. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers and remote devices. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control selection devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 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.

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. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

D. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect/ Construction Manager before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) 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 multi-pole enclosed controller. 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 multi-pole enclosed controller 11 months after date of Substantial Completion.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Enclosed controllers will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect/Construction Manager before increasing settings.

D. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

3.7 PROTECTION

A. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 262913

SECTION 264210 - UTILITY ENTRANCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Arrangement with Utility Company for permanent electric service, including payment of Utility Company charges for service construction.

B. Underground service entrance.

C. Metering equipment.

1.2 RELATED SECTIONS

A. Excavation, Grading and Fill.

C. Section 260533 - Raceways.

E. Section 260526 – Grounding and bonding.

1.3 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

1.4 SYSTEM DESCRIPTION

A. Utility Company:

1. AEP.

B. System Characteristics:

1. 480/277 volts, three phase, four wire, 60 Hertz

C. Service Entrance: Underground.

1.5 SUBMITTALS

A. Submit under provisions of Section 01340.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with Utilities Company written requirements.

B. Maintain one copy of each document on site.

1.7 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose

specified and shown.

1.8 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on Utility Company drawings.

PART 2 - PRODUCTS

2.1 UTILITY METERS

A. Provide meter can as to comply with Utility Company requirements.

2.2 METERING TRANSFORMER CABINET

A. Size and type: As required by Utility Company.

B. Include provisions for padlocking and sealing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that service equipment is ready to be connected and energized.

3.2 PREPARATION

A. Make arrangements with Utilities Company to obtain permanent electric service to the Project.

B. Coordinate location of Utilities Company’s facilities to ensure proper access is available.

C. Coordinate with utility metering department for meter and type of meter installation.

3.3 INSTALLATION

A. Install service entrance conduits and to service entrance equipment.

END OF SECTION 264210

SECTION 264313 - SURGE PROTECTION 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 SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

B. The Surge Protection Device (SPD) covered under this section includes all service entrance type surge protection devices suitable for use as Type 1(Service Entrance) or Type 2 (Distribution Panels) devices per UL1449 3rd Edition, applied to the line or load side of the utility feed inside the facility.

C. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to finish and install surge protection devises.

1.3 DEFINITIONS

A. Inominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.5 INFORMATIONAL SUBMITTALS

A. Package must include shop drawings complete with all technical information, unit dimensions, detailed installation instructions, maintenance manual, recommended replacement parts list and wiring configuration.

B. Copies of Manufacturer's catalog data, technical information and specifications on equipment proposed for use.

C. Copies of documentation stating that the Surge Protection Device is listed by UL to UL1449 3rd Edition, category code VZCA.

D. Copies of actual let through voltage data in the form of oscillograph results for both ANSI/IEEE C62.41 Category C3 (combination wave) and B3 (Ring wave) tested in accordance with ANSI/IEEE C6245.

E. Copies of Noise Rejection testing as outlined in NEMA LS1-1992 (R2000) Section 3.11. Noise rejection is to be measured between 50 kHz and 100 MHz verifying the devices noise attenuation. Must show multiple attenuation levels over a range of frequencies.

F. Copies of test reports from a recognized independent testing laboratory, capable of producing 200kA surge current waveforms, verifying the suppressor components can survive published surge current rating on a per mode basis using the ANSI/IEEE C62.41 impulse waveform C3 (8 x 20 microsecond, 20kV/10kA). Test data on an individual module is not acceptable.

G. Copy of warranty statement clearly establishing the terms and conditions to the building/facility owner/operator.

H. Field quality-control reports.

I. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Reference Standard: Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise stated in this document:

1. UL 1449 3rd Edition 2009 Revision (effective 9/29/2007).
2. UL 1283.
3. ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.

4. ANSI/IEEE C62.45, Guide for Surge Testing for equipment connected to Low-Voltage AC Power Circuits.
5. UL96A
6. IEEE 1100 Emerald Book.
7. National Fire Protection Association (NFPA 70: National Electrical Code).

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Fifteen years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers:

1. Current Technology
2. Others prior approval required before bid.

2.2 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Comply with UL 1449.

D. Comply with UL 1283.

E. MCOV of the SPD shall be the nominal system voltage.

F. Declared Maximum Continuous Operating Voltage (MCOV) shall be greater than 115 percent of the nominal system operating voltage and in compliance with test and evaluation procedures outlined in the nominal discharge surge current test of UL1449 3rd Edition, section 37.7.3. MCOV values claimed based on the component’s value or on the 30-minute 115% operational voltage test, section 38 in UL1449 will not be accepted.

G. Electrical Noise Filter- each unit shall include a high performance EMI/RFI noise rejection filter with a maximum attenuation of 54dB per MIL-STD-220B.

1. SPD shall include an EMI/RFI noise rejection filter for all L-N modes as well as a removable filter in the N-G mode.

H. The UL1449 Voltage Protective Rating (VPR) shall be permanently affixed to the SPD unit.

I. The UL1449 Nominal Discharge Surge Current Rating shall be 20kA

J. The SCCR rating of the SPD shall be 200kAIC without the need for upstream over current protection.

K. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall be no less than noted on plans The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

L. The SPD shall have the following monitoring options through the M3 Mastermind monitoring system.

1. Time Date stamp, duration and magnitude for the following power quality events (sags, swells, surges, dropouts, outages, THD, frequency, Volts RMS per phase)
2. SPD monitoring shall track surge protection and display it as a percentage of remaining protection.
3. SPD shall provide a surge counter with three categories to be defined as
4. Low Level surge (100A-500A) Medium Level surge (500A-3,000A) High Level surge (>3,000A)
5. Remote communications via Ethernet using the M4E Monitoring Option
6. Unit shall be equipped with an integral Test Port Compliant with the DTS-2 Testing Unit.
7. Indicator light display for protection status.

M. ENCLOSURES

1. Indoor Enclosures: NEMA 250, Type 1.
2. Outdoor Enclosures: NEMA 250, Type 4.

2.3 SERVICE ENTRANCE SUPPRESSOR

A. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1.

1. SPDs with the following features and accessories:

a. Integral disconnect switch.
b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.

B. Unit shall have no more than 10% deterioration or degradation of the UL1449 3rd Edition Voltage Protection Rating (VPR) when exposed to a minimum of 14,000 repeated categories C3 (20kV/10kA) surges. The SPD manufacturer must provide a test report validating the repetitive surge test was performed.

C. Protection Modes UL1449 3rd Edition VPR(6kV, 3kA) for grounded WYE/delta and High Leg Delta circuits with voltages of (480Y/277), (208Y/120), (600Y/347). 3-Phase, 4 wire circuits, (120/240) split phase shall be as follows and comply with test procedures outlined in UL1449 3rd Edition section 37.6:

System Voltage	Mode	MCOV	B3 Ringwave 6kV, 500A	C3 Comb. Wave 20kV, 10kA	UL 1449 Third Edition VPR Rating
120/240, 120/208	L-N	150	490	980	700
	L-G	150	570	980	700
	N-G	150	640	1170	700
	L-L	300	500	1600	1200
277/480	L-N	320	450	1420	1200
	L-G	320	540	1540	1200
	N-G	320	570	1600	1000
	L-L	552	530	2600	2000

D. The unit shall be able to prevent common temporary overvoltages and high impedance faults from damaging the MOVs, increasing their longevity and ability to protect the critical load. Limited and Intermediate current TOVs (as specified in UL 1449 article 39.3 and 39.4) can be caused by a loss of the neutral conductor in a split phase or three phase power system. The available fault current will be determined by the impedance of the loads connected to the phases opposite the SPD and are typically in the range of 30A to 1000A. The Selenium elements must limit voltage to the MOV as a percent of nominal as outlined below:

Overvoltage seen by MOVs as % of Nominal				
	available current			
time	30A	100A	500A	1000A
1 cycle	120%	130%	150%	160%
10 cycles	130%	150%	160%	160%
30 cycles	140%	150%	160%	160%

*To verify damage to the MOVs has been mitigated, the percent overvoltage seen at the MOV must be less than 200% for split-phase applications or 173% for three-phase applications (100% is nominal).

E. The unit shall be able to withstand multiple TOVs without damage to the MOVs by shunting current away from the MOVs during the overvoltage. SPD must have the ability to withstand >100 TOVs with a source current of 30A, duration of 30 cycles, with10s between TOV events.

F. The service entrance protector shall incorporate a combination of TPMOV and Selenium technology allowing for transient surge and temporary over voltage protection.

G. Integral Disconnect Switch (REQUIRED)

1. The device shall have an optional NEMA compliant safety interlocked integral disconnect switch with an externally mounted metal manual operator.
2. The switch shall disconnect all ungrounded circuit conductors from the distribution system to enable testing and maintenance without interruption to the facility's distribution system.
3. The switch shall be rated for 600Vac.
4. The SPD device shall be tested to UL1449 3rd Edition listed with the integral disconnect switch and the UL1449 VPR ratings shall be provided.

5. The integral disconnect switch shall be capable of withstanding, without failure, the published maximum surge current magnitude without failure or damage to the switch.
6. The line side of the integral disconnect shall be blocked off so that when the SPD is opened there is no direct access to the voltage present on the line side of the disconnect.

2.4 PANEL SUPPRESSORS

A. SPDs: Comply with UL 1449, Type 2.

1. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.

B. Unit shall have no more than 10% deterioration or degradation of the UL1449 3rd Edition Voltage Protection Rating (VPR) when exposed to a minimum of 5,000 repeated categories C3 (20kV/10kA) surges. The SPD manufacturer must provide a test report validating the repetitive surge test was performed.

C. Protection Modes UL1449 3rd Edition VPR(6kV, 3kA) for grounded WYE/delta and High Leg Delta circuits with voltages of (480Y/277), (208Y/120), (600Y/347). 3-Phase, 4 wire circuits, (120/240) split phase shall be as follows and comply with test procedures outlined in UL1449 3rd Edition section 37.6:

System Voltage	Mode	MCOV	B3 Ringwave 6kV, 500A	C3 Comb. Wave 20kV, 10kA	UL 1449 Third Edition VPR Rating
120/240, 120/208	L-N	150	760	2020	900
	L-G	150	800	1890	900
	N-G	150	930	2330	1200
	L-L	300	790	250	900
277/480	L-N	320	740	2460	1200
	L-G	320	790	2460	1500
	N-G	320	900	2640	1200
	L-L	552	870	3390	2000

2.5 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. If installed lead length exceeds 5’ installer shall use a low impedance (HPI) cable to reduce the lead lengths effect on the installed performance of the SPD.

C. Class 2 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Wiring:

1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
2. Controls: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313

SECTION 265116 - 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 incandescent, HID, LED’s and fluorescent luminaires, lamps, and ballasts.
2. Luminaire supports.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

A. BIM: Building information model.

B. CAD: Computer-aided design.

C. CCT: Correlated color temperature.

D. CRI: Color Rendering Index.

E. LED: Light-emitting diode.

F. Fixture: See "Luminaire."

G. IP: International Protection or Ingress Protection Rating

H. Lumen: Measured output of lamp and luminaire, or both.

I. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.

3. Include physical description and dimensions of luminaires.
4. Ballast, including BF.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Include photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the luminaire as applied in this Project. For LED light fixtures the adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project IES LM-79 and IES LM-80

    a. Retain or "Manufacturers' Certified Data" or "Testing Agency Certified Data" Subparagraph below. Retain first subparagraph if photometric data, based on testing by accredited manufacturers' laboratories, is considered adequate for luminaires in this Project. Retain second subparagraph if photometric data for one or more luminaires are based on independent laboratory tests; coordinate with the Interior Lighting Fixture Schedule on Drawings to indicate which units shall meet this requirement. See the Evaluations. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
    b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

7. Air and Thermal Performance Data: For air-handling luminaires. Furnish data required in "Action Submittals" Article in Section 233713 "Diffusers, Registers, and Grilles."
8. Sound Performance Data: For air-handling luminaires. Indicate sound power level and sound transmission class in test reports certified according to standards specified in Section 233713 "Diffusers, Registers, and Grilles."

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

D. Qualification Data: For testing laboratory providing photometric data for luminaires.

E. Product Certificates: For each type of ballast for bi-level and dimmer-controlled luminaires, from manufacturer.

F. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

G. Sample warranty.

1.5 PRIOR APPROVAL SUBMITTAL REQUESTS

A. Full submittal data, by type, clearly highlighted and arrowed to identify the specific proposed manufacturer's nomenclature

B. Full submittal data of lamp and proposed manufacturer.

C. Full submittal data of ballast/driver (LED) data of proposed manufacturer

D. LED lumen data will include
   1. Lumen output
   2. L70 and L90 testing
   3. Confirmation of independent test lab data ITL
   4. Color temperature and CRI with quantity of McAdam Ellipse steps
      a. Data shall include sphere and goniometer results for total lumen, total power, luminaire efficacy, CRI and junction temperature for the specified color temperature
   5. Make and brand of LED diode should be clearly identified on submittal data

E. LED dimming shall be equal in range and quality to the specified drivers, Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experience in a commercial environment.

F. All substitutions must meet specified fixtures certifications (UL, ETL, CE, CSA, RoHS, DLC, Energy Star)

G. Provide lighting calculations with the prior approval request based on reflectance values and light loss factors provided by the engineer and displayed on lighting calculation drawings. (may be unique by area). Calculations shall be shown on one sheet with dimensions as shown on construction set. Data will be submitted electronically in dxf format on a flash drive and with printed calculations on Architectural E size sheets to scale with construction set sheets.

   1. Discrepancies between prior approval data calculations and the original design calculations will result in immediate disqualification of review due to time-based constraints on the bid process

H. Prior approval request may require a sample of both the proposed and specified fixtures provided by the alternate manufacturer at NO additional cost to the project. Samples of both specified and proposed must be provided within 10 working days of request.

I. All data will be submitted electronically and in a bound format

J. Bound data will be secured in hard binder with 3" rings for ease of review or PDF file.

   1. Types will be marked with a tab by type and indexed for ease of reference

K. LED warranty information MUST be included by type and marked in RED to clearly identify the manufacturer's warranty terms. Warranty data MUST meet or exceed the specified manufacturers terms

L. Prior approvals MUST be received and acknowleged to the specifiers office no less than 10 days prior to bid.

M. ALL prior approval data must be submitted in one package with complete information. Information that is incomplete will be rejected without review.

N. The prior approval will be returned marked approved or rejected by type with no explanation. If any specification is deemed not equal the review will be stopped, the type rejected with no explanation.

O. Lumen output for the proposed fixture must be highlighted in yellow for clear identification.

P. All inverter systems supply power to LED fixtures must have pure PWM sine wave function and work with any type of lighting load.

Q. LED warranty information must be included by type and marked in red to clearly identify the manufacturer’s warranty terms. Warranty data must meet or exceed the specified manufacturers terms.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

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. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Fluorescent-luminaire-mounted emergency battery pack: One for every 40 emergency lighting unit.
4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as

defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

A. LED luminaires
   1. Provide from a single manufacturer for each luminaire type.
   2. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace (materials and labor) components of luminaires that fail in materials or workmanship within specified warranty period.

   1. Warranty Period: Two year(s) from date of Substantial Completion.

   2. LED luminaires –warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

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. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. UL Compliance: Comply with UL 1598.

E. Lamp base complying with ANSI C81.61 or IEC 60061-1.

F. Recessed Luminaires: Comply with NEMA LE 4.

G. EMI Filters: Factory installed to suppress conducted EMI according to MIL-STD-461E. Fabricate luminaires with one filter on each ballast indicated to require a filter.

H. Air-Handling Fluorescent Luminaires: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser-boot assembly specified in Section 233713 "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 luminaire door with air supply same as for air-supply units.
4. Dampers: Operable from outside luminaire for control of return-air volume.
5. Static Luminaire: Air-supply slots are blanked off, and luminaire appearance matches active units.

2.2 LED LIGHTING FIXTURES AND LED LAMPS

A. All LED products must be UL, ETL and/or CSA listed

B. All LED products must have LM-79 and LM-80 testing noted on specification sheet by an independent test lab

C. All LED products should be identified as L70 and/or L90 ratings based on independent test lab data

D. All outdoor and wet location listed products must clearly state the IP rating carried on the fixture based on independent test lab data

E. Bulb shape complying with ANSI C79.1.

F. CRI of Minimum 80. CCT of 4100 K.

G. Rated lamp life of **50,000** hours.

H. Lamps dimmable from 100 percent to 0 percent of maximum light output.

I. Nominal Operating Voltage: as noted on light fixture schedule.

J. All LED products must be serviceable for accessible for field repair needs

K. All indoor lighting color rendering should be within a 3 step McAdams ellipse. All indoor lighting should be 4000-4100 kelvin unless specifically noted

L. 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. The quantity of days required for startup will be based on the manufacturer/agents discretion and need.

1. The project integrator must be capable of performing low voltage and dmx terminations. High voltage terminations are performed solely by the electrical subcontractor.
2. Reporting of final startup completion of the controls system back to the engineer is mandatory.
3. Invitation to attend the training with the owners representative should be made to the engineer no less than 5 days prior to training
4. Signature confirmation of training and startup is required within 5 business days after completion back to the engineer's office.

M. All LED drivers should be capable of 0-10-volt controls and DMX control 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”

N. Driver manufacturers must have a 5-year history producing dimmable electronic LED drivers for the North American market.

O. Ambient driver temperatures must be within -20 degrees to 50 degrees C (-4 degrees to 122 degrees F)

P. Driver (internal) must limit inrush current.

1. Base specification: meet or exceed NEMA 410 driver inrush standard of 430 amps per 10 amps load with a maximum of 370 amps/2 seconds
2. Preferred specification: Meet or exceed 30ma’s at 277 VACS for up to 50 watts of load and 75A at 240us att 277 VAC for 100 watts of load
3. Withstand up to a 1,000-volt surge without impairment of performance as defined by ANSI C62.41 Category A
4. No visible change in light output with a variation of plus/minus 10percent line voltage input.
5. 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

2.3 CYLINDER

A. With integral mounting provisions.

2.4 DOWNLIGHT

A. Universal mounting bracket.

B. Integral junction box with conduit fittings.

2.5 LINEAR INDUSTRIAL

A. Luminaire and housing certified to the following standard[**s**].

1. Class 1, Division 2, Group(s) [**A**] [**B**] [**C**] [**and**] [**D**].
2. NEMA 4X.
3. IP 66.
4. Wet locations.
5. CSA C22.2 No 137.

2.6 PARKING GARAGE

A. Low-profile housing and heat sink.

B. Fully gasketed and sealed.

C. Stainless-steel latches.

D. Integral pressure equalizer.

2.7 RECESSED LINEAR

A. Integral junction box with conduit fittings.

2.8 STRIP LIGHT

A. Integral junction box with conduit fittings.

2.9 SURFACE MOUNT, LINEAR

A. Universal mounting bracket.

B. Integral junction box with conduit fittings.

2.10 SURFACE MOUNT, NONLINEAR

A. Universal mounting bracket.

B. Integral junction box with conduit fittings.

2.11 SUSPENDED, LINEAR

A. Ceiling mounted with two 5/32-inch diameter aircraft cable supports adjustable to 120 inches in length.

2.12 SUSPENDED, NONLINEAR

A. Universal mounting bracket.

B. Integral junction box with conduit fittings.

2.13 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. 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.

C. Diffusers and Globes:

1. Tempered Fresnel glass, prismatic glass or prismatic acrylic, refer to light fixture schedule**.**
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
4. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Housings:

1. Extruded-aluminum housing and heat sink or as noted on light fixture schedule.
2. Powder-coat finish.

E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels 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 characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI for all luminaires.

2.14 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.15 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "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 steel tubing with swivel ball fittings and ceiling canopy. Finish shall match luminaire.

C. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

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 the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Remote Mounting of Ballasts: Distance between the ballast and luminaire shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

C. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

D. Install lamps in each luminaire.

E. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them.

F. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

G. Ceiling-Grid-Mounted Luminaire Supports: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each luminaire. Locate not more than 6 inches from luminaire corners.

2. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner with clips that are UL listed for the application.
3. Luminaires of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on luminaire. Wire or rod shall have breaking strength of the luminaire weight at a safety factor of 3.

H. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

I. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls, or a minimum 20 gauge backing plate attached to wall structural members or using through bolts and backing plates on either side of wall.
2. Do not attach luminaires directly to gypsum board.

J. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and [tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

B. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

C. Luminaire will be considered defective if it does not pass operation tests and inspections.

D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Burn-in all HID lamps that require specific aging period to operate properly, prior to occupancy by Owner.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265116

SECTION 265219 - EMERGENCY AND EXIT 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. Emergency lighting units.
2. Exit signs.
3. Luminaire supports.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Fixture: See "Luminaire" Paragraph.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.

1. Include data on features, accessories, and finishes.
2. Include physical description of the unit and dimensions.
3. Battery and charger for light units.
4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.

a. Testing Agency Certified Data: For indicated luminaires and signs, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires and signs shall be certified by manufacturer.

b. Manufacturers' Certified Data: Photometric data certified by 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 luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule:

1. For emergency lighting units. Use same designations indicated on Drawings.
2. For exit signs. Use same designations indicated on Drawings.

D. Qualification Data: For testing laboratory providing photometric data for luminaires.

E. Product Certificates: For each type of luminaire.

F. Product Test Reports: For each luminaire for tests performed by manufacturer and witnessed by a qualified testing agency.

G. Sample Warranty: For manufacturer’s special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

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. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Luminaire-mounted, emergency battery pack: One for every 20 emergency lighting units. Furnish at least one of each type.
3. Diffusers and Lenses: two for every 100 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace (materials and labor) components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two year(s) from date of Substantial Completion.

B. 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 Power Unit Batteries: **5** years from date of Substantial Completion. Full warranty shall apply for first year and prorated warranty for the remaining four years.
2. Warranty Period for Emergency Fluorescent Ballast and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year and prorated warranty for the remaining six year**s**.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

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. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Comply with NEMA LE 4 for recessed luminaires.

E. Comply with UL 1598 for fluorescent luminaires.

F. Lamp Base: Comply with ANSI C81.61 or IEC 60061-1.

G. Bulb Shape: Complying with ANSI C79.1.

H. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with ballast.

1. Emergency Connection: Operate two lamp(s) continuously at an output of 1100 lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
2. 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.
3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Less than 0 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.
    b. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
    c. Humidity: More than 95 percent (condensing).
    d. Altitude: Exceeding 3300 feet.

4. Nightlight Connection: Operate lamp continuously at 40 percent of rated light output.
5. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire 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.

6. Battery: Sealed, maintenance-free, nickel-cadmium type.
7. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
8. 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.

I. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.

1. Emergency Connection: Operate fluorescent or LED lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
2. 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.
3. Nightlight Connection: Operate lamp in a remote luminaire continuously.
4. Battery: Sealed, maintenance-free, nickel-cadmium type.
5. Charger: Fully automatic, solid-state, constant-current type.
6. Housing: NEMA 250, Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly shall be located no less than half the distance recommended by the ballast/emergency power unit manufacturer, whichever is less.
7. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
8. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
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.

2.2 EMERGENCY LIGHTING

A. General Requirements for Emergency Lighting Units: Self-contained units.

B. Emergency Luminaires:

1. Emergency Luminaires: as indicated on Drawings, with the following additional features:
   a. Rated for installation in damp locations, and for sealed and gasketed luminaires in wet locations.

C. Emergency Lighting Unit:

1. Emergency Lighting Unit: as indicated on Drawings.
2. Wall with universal junction box adaptor.
3. UV stable thermoplastic housing rated for damp locations.

D. Remote Emergency Lighting Units:

1. Emergency Lighting Unit: as indicated on Drawings.
2. Wall with universal junction box adaptor.
3. UV stable thermoplastic housing rated for damp locations.
4. External emergency power unit.

2.3 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 luminaire; 20,000 hours of rated lamp life.
   2. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
   3. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

C. Self-Luminous Signs:

   1. Powered by tritium gas, with universal bracket for flush-ceiling, wall, or end mounting. Signs shall be guaranteed by manufacturer to maintain the minimum brightness requirements in UL 924 for 20 years.
   2. Use strontium oxide aluminate compound to store ambient light and release the stored energy when the light is removed. Include universal bracket for flush-ceiling, wall, or end mounting.

2.4 MATERIALS

A. Metal Parts:

   1. Free of burrs and sharp corners and edges.
   2. Sheet metal components shall be steel unless otherwise indicated.
   3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

   1. Smooth operating, free of light leakage under operating conditions.
   2. Designed to permit relamping without use of tools.
   3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:

   1. Glass: Annealed crystal glass unless otherwise indicated.
   2. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Housings:

   1. Powder coat finish.

2.5 METAL FINISHES

A. 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.

2.6 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Support Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, and 12 gage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire and emergency power unit weight.
2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.

E. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls, or a minimum 20 gauge backing plate attached to wall structural members or using through bolts and backing plates on either side of wall.
2. Do not attach luminaires directly to gypsum board.

F. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

G. Ceiling Grid Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service:

1. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

3.6 ADJUSTING

A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:

1. Inspect all luminaires. Replace lamps, emergency power units, batteries, signs, or luminaires that are defective.

    a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

2. Conduct short-duration tests on all emergency lighting.

END OF SECTION 265219

SECTION 265613 - LIGHTING POLES AND STANDARDS

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. Poles and accessories for support of luminaires.
2. Luminaire-lowering devices.

1.3 DEFINITIONS

A. EPA: Equivalent projected area.

B. Luminaire: Complete lighting fixture.

C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.

D. Standard: See "Pole."

1.4 ACTION SUBMITTALS

A. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device, arranged as indicated.

1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
2. Include finishes for lighting poles and luminaire-supporting devices.
3. Anchor bolts.
4. Manufactured pole foundations.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of poles and pole accessories.
4. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.
5. Anchor bolt templates keyed to specific poles and certified by manufacturer.

6. Method and procedure of pole installation. Include manufacturer's written installations.

C. Samples: For each exposed lighting pole, standard, and luminaire-supporting device and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements according to AASHTO LTS-6-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations signed and sealed by a professional engineer.

B. Qualification Data: For testing agency.

C. Material Test Reports:

1. For each foundation component, by a qualified testing agency.
2. For each pole, by a qualified testing agency.

D. Source quality-control reports.

E. Field quality-control reports.

F. Sample Warranty: Manufacturer's standard warranty.

G. Soil test reports

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For poles to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include pole inspection and repair procedures.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Pole repair materials.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for foundation testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on fiberglass and laminated wood poles until right before pole installation. Handle poles with web fabric straps.

D. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) 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 a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.

1. Warranty Period: Five years from date of Substantial Completion.
2. Warranty Period for Corrosion Resistance: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products as listed on light fixture schedule and plans.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design pole foundation and pole power system.

B. Structural Characteristics: Comply with AASHTO LTS-6-M.

C. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.

D. Live Load: Single load of 500 lbf distributed according to AASHTO LTS-6-M.

E. Ice Load: Load of 3 lbf/sq. ft., applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.

F. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.

G. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.

H. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.3 ALUMINUM POLES

A. Poles: Seamless, extruded structural tube complying with ASTM B 221, Alloy 6061-T6, with access handhole in in pole wall.

1. Shape: round tapered, round, straight, square, straight (as noted on drawings)
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

B. Mast Arms: Aluminum Single-arm type, continuously welded to pole attachment plate. Material and finish same as plate.

C. Brackets for Luminaires: Detachable, cantilever, without underbrace.

1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with stainless steel bolts.
2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.

D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

E. Grounding and Bonding Lugs: Bolted 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

F. Fasteners: Stainless steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.

1. Materials: Compatible with poles and standards as well as to substrates to which poles and standards are fastened and 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.

G. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.

H. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

I. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I clear coating of 0.018 mm or thicker), complying with AAMA 611.
4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

J. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Powder coat shall comply with AAMA 2604.

    a. Electrostatic applied powder coating; single application with a minimum 2.5- to 3.5-mils dry film thickness; cured according to manufacturer's instructions. Coat interior and exterior of pole for equal corrosion protection.
    b. Color: As selected by Architect from manufacturer's full range.

2.4 POLE ACCESSORIES

A. Duplex Receptacle: Ground-fault circuit interrupter type, 120 V ac, 20 A in a weatherproof assembly. Comply with requirements in Section 262726 "Wiring Devices."

1. Recessed 12 inches above finished grade.

    a. NEMA 250, Type 3R, nonmetallic polycarbonate plastic or reinforced fiberglass, enclosure with cover; color to match pole.
    b. Lockable hasp and latch complying with OSHA lockout and tag-out requirements.

B. Minimum 1800-W transformer, protected by replaceable fuses, mounted behind access cover.

C. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

2.5 MOUNTING HARDWARE

A. Anchor Bolts: Manufactured to ASTM F 1554, Grade 55, with a minimum yield strength of 55,000 psi.

1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
2. Bent or Headed rods, diameter and length as required by manufacturer.
3. Threading: Uniform National Coarse or Uniform National 8, Class 2A.

B. Nuts: ASTM A 563, Grade A, Heavy-Hex

1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
2. Four nuts provided per anchor bolt, shipped with nuts pre-assembled to the anchor bolts.

C. Washers: ASTM F 436, Type 1.

1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
2. Two washers provided per anchor bolt.

2.6 GENERAL 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 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine poles, luminaire-mounting devices, lowering devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.

C. Examine roughing-in for foundation and conduit to verify actual locations of installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 POLE FOUNDATION

A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123 M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

B. Anchor Bolts: Install plumb using manufacturer-supplied plywood template, uniformly spaced.

3.3 POLE INSTALLATION

A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.

1. Fire Hydrants and Water Piping: 60 inches.
2. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet.
3. Trees: 15 feet from tree trunk.
4. Overhead Utility lines: 15 feet from nearest conductor (confirm with utility company prior to rough in).

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."

D. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.
1. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
2. Install base covers unless otherwise indicated.
3. Use a short piece of 1/2 -inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch below top of concrete slab.

F. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.4 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.

B. Steel Conduits: Comply with requirements in Section 260533 "Raceways 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.

3.5 GROUNDING

A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "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.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Inspect poles for nicks, mars, dents, scratches, and other damage.
2. System function tests.

END OF SECTION 265613

SECTION 265621 - 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 HID and compact fluorescent luminaires, lamps, and ballasts.
2. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
3. Luminaire-mounted photoelectric relays.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 265613 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. HID: High-intensity discharge.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

G. Pole: Luminaire support structure, including tower used for large-area illumination.

H. Standard: See "Pole."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of the luminaires.
4. Ballast, including BF, UL listing and recognition, ANSI certification, and Energy Independence and Security Act of 2007 compliance.
5. Lamps, including life, output (lumens, CCT, and CRI), and energy-efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides," of each luminaire type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the luminaire as applied in this Project.
   For LED luminaires the adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project IES LM-79 and IES LM-80.

   a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
   b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

7. Photoelectric relays.
8. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Include diagrams for power, signal, and control wiring.

D. Samples: For products designated for sample submission in the Exterior Lighting Fixture Schedule.

E. Samples for Initial Selection: For each type of luminaire with custom, factory-applied finish.

1. Include Samples of luminaires and accessories involving color and finish selection.

F. Samples for Verification: For each type of luminaire.

1. Include Samples of luminaires and accessories to verify finish selection.
2. Lamps and ballasts, installed.
3. Cords and plugs.
4. Support system.

G. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: 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. Luminaires.
2. Structural members to which equipment and luminaires will be attached.
3. Underground utilities and structures.
4. Existing underground utilities and structures.
5. Above-grade utilities and structures.
6. Existing above grade utilities and structures.
7. Building features.
8. Vertical and horizontal information.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of the following:

1. Ballast for bi-level and dimmable luminaires.
2. Lamp.
3. Photoelectric relay.

E. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

F. Sample warranty.

1.6 PRIOR APPROVAL SUBMITTAL REQUESTS

A. Full submittal data, by type, clearly highlighted and arrowed to identify the specific proposed manufacturer’s nomenclature

B. Full submittal data of lamp and proposed manufacturer.

C. Full submittal data of ballast/driver (LED) data of proposed manufacturer

D. LED lumen data will include
1. Lumen output
2. L70 and L90 testing
3. Confirmation of independent test lab data ITL
4. Color temperature and CRI with quantity of McAdam Ellipse steps
    a. Data shall include sphere and goniometer results for total lumen, total power, luminaire efficacy, CRI and junction temperature for the specified color temperature
5. Make and brand of LED diode should be clearly identified on submittal data

E. LED dimming shall be equal in range and quality to the specified drivers, Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experience in a commercial environment.

F. All substitutions must meet specified fixtures certifications (UL, ETL, CE, CSA, RoHS, DLC, Energy Star)

G. Provide lighting calculations with the prior approval request based on reflectance values and light loss factors provided by the engineer and displayed on lighting calculation drawings. (may be unique by area). Calculations shall be shown on one sheet with dimensions as shown on construction set. Data will be submitted electronically in dxf format on a flash drive and with printed calculations on Architectural E size sheets to scale with construction set sheets.

1. Discrepancies between prior approval data calculations and the original design calculations will result in immediate disqualification of review due to time-based constraints on the bid process

H. Prior approval request may require a sample of both the proposed and specified fixtures provided by the alternate manufacturer at NO additional cost to the project. Samples of both specified and proposed must be provided within 10 working days of request.

I. All data will be submitted electronically and in a bound format

J. Bound data will be secured in hard binder with 3” rings for ease of review or PDF file.

1. Types will be marked with a tab by type and indexed for ease of reference

K. LED warranty information MUST be included by type and marked in RED to clearly identify the manufacturer’s warranty terms. Warranty data MUST meet or exceed the specified manufacturers terms

L. Prior approvals MUST be received and acknowledged to the specifiers office no less than 10 days prior to bid.

M. ALL prior approval data must be submitted in one package with complete information. Information that is incomplete will be rejected without review.

N. The prior approval will be returned marked approved or rejected by type with no explanation. If any specification is deemed not equal the review will be stopped, the type rejected with no explanation.

O. Lumen output for the proposed fixture must be highlighted in yellow for clear identification.

P. All inverter systems supply power to LED fixtures must have pure PWM sine wave function and work with any type of lighting load.

Q. LED warranty information must be included by type and marked in red to clearly identify the manufacturer’s warranty terms. Warranty data must meet or exceed the specified manufacturers terms.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires to include in [**operation**] and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

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. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
2. Glass, Acrylic, and Plastic Lenses Covers and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.
5. Ballasts: One for every 100 f each type and rating installed. Furnish at least one of each type.

1.9 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.11 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.12 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace (labor and material) components of luminaires that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including luminaire support components.
b. Faulty operation of luminaires, ballasts, and accessories.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

B. Warranty Period: Two year(s) from date of Substantial Completion.

A. LED luminaires Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

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. NRTL Compliance: Luminaires shall comply with UL 1598 and be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. Lateral Light Distribution Patterns: Comply with IES RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

E. UL Compliance: Listed for wet location (UL 1598).

F. Lamp base complying with ANSI C81.61 or IEC 60061-1.

G. EMI Filters: Factory installed to suppress conducted EMI as required by MIL-STD-461E. Fabricate luminaires with one filter on each ballast indicated to require a filter.

H. In-line Fusing: Install on the ballast primary for each luminaire.

I. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.

J. Source Limitations: Obtain luminaires from single source from a single manufacturer.

K. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 LED LIGHTING FIXTURES AND LED LAMPS

A. All LED products must be UL, ETL and/or CSA listed

B. All LED products must have LM-79 and LM-80 testing noted on specification sheet by an independent test lab

C. All LED products should be identified as L70 and/or L90 ratings based on independent test lab data

D. All outdoor and wet location listed products must clearly state the IP rating carried on the fixture based on independent test lab data

E. Bulb shape complying with ANSI C79.1.

F. CRI of Minimum 80. CCT of 4100 K.

G. Rated lamp life of **50,000** hours.

H. Lamps dimmable from 100 percent to 0 percent of maximum light output.

I. Nominal Operating Voltage: as noted on light fixture schedule.

J. All LED products must be serviceable for accessible for field repair needs.

K. All outdoor pole mounted products must have surge suppression within each fixture.

L. All outdoor lighting color rendering should be within a 7 step McAdams Ellipse. All outdoor lighting should be 4000 kelvin unless specifically noted

M. 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. The quantity of days required for startup will be based on the manufacturer/agents discretion and need.

1. The project integrator must be capable of performing low voltage and dmx terminations. High voltage terminations are performed solely by the electrical subcontractor.
2. Reporting of final startup completion of the controls system back to the engineer is mandatory.
3. Invitation to attend the training with the owners representative should be made to the engineer no less than 5 days prior to training
4. Signature confirmation of training and startup is required within 5 business days after completion back to the engineer's office.

N. All LED drivers should be capable of 0-10 volt controls and DMX control 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"

O. Driver manufacturers must have a 5 year history producing dimmable electronic LED drivers for the North American market.

P. Ambient driver temperatures must be within -20 degrees to 50 degrees C (-4 degrees to 122 degrees F)

Q. Driver (internal) must limit inrush current.

1. Base specification: meet or exceed NEMA 410 driver inrush standard of 430 amps per 10 amps load with a maximum of 370 amps/2 seconds
2. Preferred specification: Meet or exceed 30ma's at 277 VAC for up to 50 watts of load and 75A at 240us att 277 VAC for 100 watts of load
3. Withstand up to a 1,000-volt surge without impairment of performance as defined by ANSI C62.41 Category A
4. No visible change in light output with a variation of plus/minus 10percent line voltage input.
5. 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

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnof**f.**

1. Relay with locking-type receptacle shall comply with ANSI C136.10.
2. Adjustable window slide for adjusting on-off set points.

2.4 LUMINAIRE TYPES - see light fixture schedule on plans

2.5 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum or Stainless steel unless otherwise indicated. Form and support to prevent warping and sagging.

C. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

D. 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. Ballast shall automatically disconnect ballast when door opens.

E. Exposed Hardware Material: Stainless steel.

F. Diffusers and Globes:

1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

G. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

H. 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.

I. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

J. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. 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 characteristics:

a. "USE ONLY," including specific lamp type.
b. Lamp type, wattage, bulb type, and coating (clear or coated) for HID luminaires.
c. ANSI ballast type (M98, M57, etc.) for HID luminaires.
d. CCT and CRI for all luminaires.

2.6 METAL FINISHES

A. Variations in Finishes: 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.

B. 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.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker), complying with AAMA 611.
4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

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 the Work.

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls, roofs, and canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Install lamps in each luminaire.

D. Remote Mounting of Ballasts: Distance between the ballast and luminaire shall not exceed that recommended by ballast manufacturer. Verify the following with ballast manufacturer:

1. Maximum distance between ballast and luminaire.
2. Wire size between ballast and luminaire.

E. Wiring Method: Install cables in raceways. Conceal raceway and cables.

F. Fasten luminaire to indicated structural supports.

G. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

H. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls, or a minimum 1/8-inch backing plate attached to wall structural members or using through bolts and backing plates on either side of wall.

I. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height indicated on Drawings.

J. Coordinate layout and installation of luminaires with other construction. Refer to architectural elevations prior to rough-ins.

K. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

L. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems;" for wiring connections and wiring methods.

3.4 BOLLARD LUMINAIRE INSTALLATION

A. Align units for optimum directional alignment of light distribution.

1. Install on concrete base with top 4 inches above finished grade or surface at location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.5 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

A. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.6 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 Section 260533 "Raceways 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.

3.7 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Photoelectric Control Operation: Verify operation of photoelectric controls.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):

a. IES LM-5.
b. IES LM-50.
c. IES LM-52.
d. IES LM-64.
e. IES LM-72.

D. 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.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

3.10 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner.

3.11 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265621

PART 1 - GENERAL

1.1 SUMMARY

A. Provide an addressable control panel with voice evacuation, manual and automatic initiation devices plus 100% expansion in the future and associated raceways and power connection for power supplies for a complete installation. Indicating devices shall also be provided to comply with TDLR. Including with all hardware/components necessary for an IP and cellular alarm communications.

B. Fully coordinate with Elevator Contractor for the Fire Alarm interfacing.

C. Fully coordinate with the food service contractor for the kitchen hood fire suppression interfacing.

D. Fully coordinate with the Fire Sprinkler System Tamper and Flow Switches for the Fire Alarm interfacing.

E. Fully coordinate with the HVAC contractor for the Fire Alarm HVAC equipment (over 2,000 cfm's) duct smoke detectors interfacing.

F. Related Sections: The following Sections contain requirements that relate to this Section:

1. HVAC Controls - "Electric Control Systems for duct smoke detectors. HVAC down relay. (AHU shut down relay furnished by Fire Alarm Contractor).

G. Definitions:

1. FACP: Fire alarm control panel.
2. LED: Light-emitting diode.
3. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

H. System Description:

1. Noncoded, addressable system; multiplexed signal transmission dedicated to fire alarm service only.

I. Performance Requirements:

1. Comply with NFPA 72.
2. Fire alarm signal initiation shall be by one or more of the following devices:

a. Manual stations.
b. Heat detectors.
c. Smoke detectors.
d. Verified automatic alarm operation of smoke detectors.
e. Automatic sprinkler system water flow.
f. Fire extinguishing system operation.

3. Fire alarm signal shall initiate the following actions:

    a. Visual notification appliances shall operate continuously.
    b. Identify alarm at the FACP and remote annunciators.
    c. Audible notification appliances shall operate continuously until silenced.
    d. Visual notification appliances shall continue to operate until reset.
    e. Switch heating, ventilating, and air-conditioning equipment controls to fire alarm mode.
    f. Release fire and smoke doors held open by magnetic door holders.
    g. Transmit an alarm signal to the remote alarm receiving station
    h. Record events in the system memory.

4. Supervisory signal initiation shall be by one or more of the following devices or actions:

    a. Operation of a fire-protection system valve tamper.
    b. Operation of a fire-protection system valve flow.

5. System trouble signal initiation shall be (per building) by one or more of the following devices or actions:

    a. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.
    b. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating devices.
    c. Loss of primary power at the FACP.
    d. Ground or a single break in FACP internal circuits.
    e. Abnormal ac voltage at the FACP.
    f. A break in standby battery circuitry.
    g. Failure of battery charging.
    h. Abnormal position of any switch at the FACP or annunciator.
    i. Fire-pump power failure, including a dead-phase or phase-reversal condition.

6. System Trouble and Supervisory Signal Actions: Ring trouble bell and annunciate at the FACP and remote annunciators. Record event.

J. AHU SHUT DOWN

1. When a fire alarm condition is detected by AHU duct smoke detector and reported, the following functions shall immediately occur:

    a. The system alarm LED on the FACP shall flash.
    b. A local piezo electric signal in the control panel shall sound.
    c. A backlit 80-character LCD display on the FACP shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
    d. This particular AHU shall be shut down only; the remaining AHU’s shall remain operational.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. 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.
2. Device Address List: Coordinate with final system programming.
3. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.
4. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.
5. Batteries: Size calculations.

C. Field quality-control test reports.

D. Operation and maintenance data.

E. 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.

F. 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, Architect, and authorities having jurisdiction.
    b. Electronic media may be provided to Architect and authorities having jurisdiction.

1.3 QUALITY ASSURANCE

A. Installer Qualifications:
1. Installer shall provide proof of their qualifications as Factory Authorized and Factory Trained for the product(s) specified herein. These documents 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.
2. The installing Contractor (Company) shall have completed a minimum of five projects of similar size and scope within the past five years. Provide a list of completed projects to

include names and phone numbers of the Owner's representative and the General Contractor for the project.

3. Contractor Personnel Requirements:
   a. One full time employee with a current Texas Fire Alarm Planning Superintendents License.
   b. One full time employee with NICET Level III certification.
   c. A minimum of two technicians with Factory Training for the submitted product(s). Copies of License, NICET Certification, and Factory Training shall be included in the submittals.
   d. The installation shall be performed by licensed full time employees of the Factory Authorized Distributor.

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. A factory-authorized Installer is to perform the Work of this Section. Installer is to be licensed by Texas Commission on Fire Protection as Fire Alarm Technician or Fire Alarm Planning Superintendent. Texas Commission on Fire Protection shall license installing company. Provide copies of licensing with submittal.

D. Compliance with Local Requirements: Comply with the applicable building code, local ordinances, and regulations, and the requirements of the authority having jurisdiction.

E. Comply with Article 5.43-2 Insurance code and fire alarm rules as required by Texas Commission on Fire Protection.

F. Comply with Article 5.43-2 Insurance code and fire alarm rules as required by Texas Commission on Fire Protection.

G. NFPA Compliance: Provide fire alarm and detection systems conforming to the requirements of the following publications:

   1. NFPA 72, "Installation, Maintenance, and Use of Protective Signaling Systems."
   2. NFPA 72E, "Automatic Fire Detectors."
   3. NFPA 72G, "Guide for the Installation, Maintenance and Use of Notification Appliances for Protective Signaling Systems."

H. NRTL Listing: Provide systems and equipment that are listed and labeled.
   1. Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

I. UL Compliance: All devices are to be UL listed for Fire, Security, and Access Control.

J. Single-Source Responsibility: Obtain fire alarm components from a single source who assumes responsibility for compatibility for system components.

1.4 WARRANTY

A. Guarantee all labor and equipment furnished under this bid package for a period of five (5) years commencing from the date of final system acceptance, including annual inspections of the system.

B. During the warranty period report to the site and repair or replace any defective materials or workmanship without cost to the Owner. Warranty service shall be rendered within 24 hours after request by Owner. Equivalent replacement equipment shall be temporarily provided when immediate on-site repairs cannot be made.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. FACP with voice evacuation and Equipment:

    a. Silent Knight 5820XL-EVS

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. Edwards Systems Technology Inc.
    b. Commercial Products Group.
    c. Gentex Corporation.
    d. System Sensor; a GE-Honeywell Company.

2.2 FACP

A. General Description:

1. Modular, power-limited design with electronic modules, UL 864 listed.
2. Addressable control circuits for operation of mechanical equipment.

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: Liquid-crystal type, three line(s) of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

C. Circuits:

1. Signaling Line Circuits: NFPA 72, Class B, Style 4.

a. System Layout: Install no more than 100 addressable devices on each signaling line circuit.

2. Notification-Appliance Circuits: NFPA 72, Class A, Style Z.
3. Notification-Appliance Circuits: NFPA 72, Class B, Style Y.
4. Actuation of alarm notification appliances, emergency voice communications, annunciation, elevator recall, and actuation of suppression systems shall occur within 10 seconds after the activation of an initiating device.
5. Electrical monitoring for the integrity of wiring external to the FACP for mechanical equipment shutdown and magnetic door-holding circuits is not required, provided a break in the circuit will cause doors to close and mechanical equipment to shut down.

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.
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 [120 beats per minute, march-time pattern].

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. Transmission to Remote Alarm Receiving Station: Provide and install IPGSM cellular communicator by Honeywell and provide monitoring for 1 year. Automatically transmit alarm, trouble, and supervisory signals to a remote alarm station through this cellular communicator.

J. 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 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."

K. Secondary Power: 24-V dc supply system with batteries and automatic battery charger and an automatic transfer switch.

1. Batteries: Gell Cell.
2. Battery and Charger Capacity: Comply with NFPA 72.

L. Surge Protection:

1. Install surge protection on normal ac power for the FACP and its accessories. Comply with Division 16 Section "Transient Voltage Suppression" for auxiliary panel suppressors.
2. Install surge protectors recommended by FACP manufacturer. Install on all system wiring external to the building housing the FACP.

M. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

N. The fire alarm control panel shall have the capability to support remote monitoring and control via LAN, WAN or Internet connection to a remote graphics workstation in real time.

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.
2. Station Reset: Key- or wrench-operated switch.
3. Provide all manual stations with STI 1100 protective cover.

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. 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.

B. Photoelectric Smoke Detectors:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.
2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

C. Duct Smoke Detectors:

1. Photoelectric Smoke Detectors:

    a. Sensor: LED or infrared light source with matching silicon-cell receiver.
    b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

2. UL 268A listed, operating at 24-V dc, nominal.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
4. 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.
5. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type. Indicating detector has operated status. Provide remote status and alarm indicator and test station where indicated.
7. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
8. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

D. Single-Station Duct Detectors:

1. UL 268A listed, operating at 120-V ac.
2. Sensor: LED or infrared light source with matching silicon-cell receiver.

a. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

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.
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 status. Provide remote status and alarm indicator and test station where indicated.
6. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
7. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.5 HEAT DETECTORS

A. General: UL 521 listed.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or rate-of-rise of temperature that exceeds 15 deg F per minute, unless otherwise indicated.

1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.

1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

2.6 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.

2. All appliances that are supplied for the requirements of this specification shall be UL Listed for Fire Protective Service, and shall be capable of providing the "equivalent facilitation" which is allowed under the Americans with Disabilities Act Accessibilities Guidelines (ADAAG)), and shall be UL 1971 Listed.

3. All appliances shall be of the same manufacturer as the fire alarm control panel specified to insure absolute compatibility between the appliances and the control panels, and to

insure that the application of the appliances are done in accordance with the single manufacturer's instructions.

4. Any appliances that do not meet the above requirements, and are submitted for use must show written proof of their compatibility for the purpose intended. Such proof shall be in the form of documentation from all manufacturers that clearly states that their equipment (as submitted) is 100% compatible with each other for the purpose intended. All strobes shall be provided with lens markings oriented for wall mounting.

5. Notification appliances shall be synchronized in hallways and in any area where two more appliances are visible.

6. All notification appliances shall be white unless noted otherwise on the drawings.

B. Speaker-Strobes: Provide 4" white speakers/strobes at the locations shown on the drawings. Speakers shall have a 4" mylar cone, paper cones are not acceptable. The rear of the speakers shall be completely sealed protecting the cone during and after installation. In and out screw terminals shall be provided for wiring. Speakers shall provide 1/4w, 1/2w, 1w, and 2w power taps for use with 25V or 70V systems. At the 2-watt setting, the speaker shall provide an 87-dBA sound output over a frequency range of 400-4000 Hz. when measured in reverberation room per UL-1480. Strobes shall provide synchronized flash. Strobe output shall be determined as required by its specific location and application from a family of 15/75cd, 30cd, & 110cd devices.

C. Low Profile Horns: Provide low profile wall mount horns at the locations shown on the drawings. The horn shall provide an 84-dBA sound output at 10 ft. when measured in reverberation room per UL-464. The horn shall have a selectable steady or synchronized temporal output. In and out screw terminals shall be provided for wiring. The horn shall mount in a North American 1-gang box.

D. Low Profile Strobes Horns: Provide low profile wall mount horn/strobes at the locations shown on the drawings. The horn/strobe shall provide an audible output of 84 dBA at 10 ft. when measured in reverberation room per UL-464. Strobes shall provide synchronized flash outputs. The strobe output shall be determined as required by its specific location and application from a family of 15cd, 30cd, 60cd, 75cd & 110cd devices. The horn shall have a selectable steady or synchronized temporal output. In and out screw terminals shall be provided for wiring. Low profile horn/strobes shall mount in a North American 1-gang box.

E. Low profile strobes: 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- high letters on the lens.

1. Rated Light Output: 75 110 candela or as noted on plans.
2. Strobe Leads: Factory connected to screw terminals.

2.7 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching door plate.

1. Electromagnet: Requires no more than 3 W to develop 25-lbf (111-N) holding force.
2. Wall-Mounted Units: Flush mounted, unless otherwise indicated.
3. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.8 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.

2.9 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.

B. Integral Relay: Capable of providing a direct signal [to the elevator controller to initiate elevator recall] [to a circuit-breaker shunt trip for power shutdown] <Insert other functions>.

2.10 IP FIRE ALARM COMMUNICATOR TRANSMITTER

A. UL 864 listed for signaling under Other Transmission Technologies and comply with NFPA 72 requirements

B. Metal enclosure to mount next to a UL listed fire alarm control panel.

C. Two supervised inputs and two additional outputs.

D. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically captures the cellular alarm communicator (Telguard TG-7) dials a preset number for a remote central station.

E. Supports both dynamic (DHCP) or Public and Private Static IP address.

F. Supports dual-destination IP receiver address for high redundancy configurations.

G. RJ45X Ethernet Termination

H. Silent Knight SK-IP

2.11 CELLULAR ALARM COMMUNICATOR FOR 3G/4G NETWORKS

A. UL Listings 864

B. Full data reporting

C. Automatic self-test

D. Locking metal enclosure

E. Telguard TG-7

2.12 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.

2.13 AUDIO AMPLIFIERS

A. Each audio power amplifier shall have integral audio signal de-multiplexers, allowing the amplifier to select any one of eight digitized audio channels. The channel selection shall be directed by the system software. Up to 8 multiple and different audio signals must be able to be broadcast simultaneously from the same system network node.

B. Each amplifier output shall include a dedicated, supervised 25/70 Vrms speaker circuit that is suitable for connection of emergency speaker appliances. Each amplifier shall also include a notification appliance circuit rated at 24Vdc @ 3.5A for connection of visible (strobe) appliances. This circuit shall be fully programmable and it shall be possible to define the circuit for the support of audible, visible, or ancillary devices.

C. In the event of a total loss of audio data communications, all amplifiers will default to the local “EVAC” tone generator channel. If the local panel has an alarm condition, then all amplifiers will sound the EVAC signal on their connected speaker circuits.

2.14 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. 18 AWG size as recommended by system manufacturer.

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.

D. Underground cabling: Please provide water resistant/water blocking type, equal to West Penn “Aquaseal”.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Connecting to Existing Equipment: Verify that existing fire alarm system is operational before making changes or connections.

1. Connect new equipment to the existing control panel in the existing part of the building.
2. Expand, modify, and supplement the existing control equipment as necessary to extend the existing control functions to the new points. New components shall be capable of merging with the existing configuration without degrading the performance of either system.

B. Smoke or Heat Detector Spacing:

1. Smooth ceiling spacing shall not exceed the rating of the detector.
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.

C. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.

D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of the duct.

E. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

F. 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.

G. Audible Alarm-Indicating Devices: Install not less than 80 inches above the finished floor nor less than 6 inches below the ceiling whichever is lower.

H. Visual Alarm-Indicating Devices: Install as shown and not less than 80 inches above the finished floor or 6 inches below the ceiling whichever is lower.

I. Device Location-Indicating Lights: Locate in public space near the device they monitor.

J. FACP: Flush mount with tops of cabinets not more than 72 inches above the finished floor.

K. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

L. Manual Pull Stations: Mount semi-flush in recessed back boxes with operating handles 48 inches above finished floor or as indicated.

3.2 WIRING INSTALLATION

A. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceways and Boxes for Electrical Systems."

1. NECA 1.
2. TIA/EIA 568-A.
3. Public areas with exposed structure, all wiring shall be concealed in raceway.
4. Stub up raceways into accessible ceiling space.
5. Install wiring in raceways except in accessible indoor ceiling spaces. Secure wiring from building structure steel (no walls) by means of J-hooks. Where available lay out cables in cable tray.
6. Conceal raceways and wiring except in unfinished spaces and as indicated.
7. Minimum conduit size shall be 1/2 inch. Control and data transmission wiring shall not share conduit with other building wiring systems.
8. 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: Install wiring in metal raceway according to Division 26 Section "Raceways and Boxes for Electrical Systems."

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.

C. 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 not permitted.

3. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or raceway as signaling line circuits.

D. 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.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

F. 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.

G. Wiring to Remote Alarm Transmitting Device: 1-inch 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. Paint power-supply disconnect switch red and label "FIRE ALARM."

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. 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.
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.

    a. Detectors that are outside their marked sensitivity range shall be replaced.

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 MONITORING

A. Include in bid proposal the cost for 1 year remote monitoring. Monitoring station shall UL listed and 24 hour 365 days operation.

3.7 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 Project outside normal occupancy hours for this purpose.

B. Semiannual Test and Inspection: Six months after date of Substantial Completion and for the following three years, 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.

3.8 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 267210

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 direct-connected, manually switched, school intercom and program equipment independent of telephone equipment.

B. Provide conduit, wire, and outlets; splice boxes as shown on plans and as herein specified to expand/provide a complete Sound and Voice Communication Systems.

1.3 PERFORMANCE REQUIREMENTS

A. Handset Station: Capable of the following functions:

1. Having privacy from remote monitoring without a warning tone signal at monitored station.
2. Returning a busy signal to indicate station is already in use.

B. Speakers: Free from noise and distortion during operation and when in standby mode.

1.4 SUBMITTALS

A. Product Data: For each component.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location of each field connection.

1. Station-Arrangement Details: Scaled drawings for built-in equipment.
2. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring. Include a single-line diagram showing cabling interconnection of components.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Include record of final matching transformer-tap settings, and signal ground-resistance measurement certified by Installer.

D. Maintenance Data: For equipment to include in maintenance manuals specified in Division 1.

1. Include record of Owners equipment-programming option decisions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications
   1. An experienced installer who is an authorized representative of equipment manufacturer for both installation and maintenance of equipment required for this Section. It shall provide proof of their qualifications as Factory Authorized and Factory Trained for the product(s) specified herein. These documents 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.
   2. The installing Contractor (Company) shall have completed a minimum of five projects of similar size and scope within the past five years. Provide a list of completed projects to include names and phone numbers of the Owner's representative and the General Contractor for the project.
   3. A minimum of two technicians shall be Factory Trained for the submitted product(s). Technicians shall be full time employees of the Contractor. Factory Certifications shall be included in the submittals.

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.

C. Comply with NFPA 70.

D. Comply with UL 50.

1.6 OCCUPANCY ADJUSTMENTS

A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions. Provide up to three on-site assistance visits within one year of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Class Connection by Valcom
   2. CareHawk
   3. Others prior approval before bid.

2.2 EQUIPMENT AND MATERIALS

A. Coordinate features to form an integrated system. Match components and interconnections for optimum performance of specified functions.

B. Expansion Capability: Increase number of stations in the future by 25 percent above those indicated without adding any internal or external components or main trunk cable conductors. Up to 360 stations.

C. Equipment: Modular type using solid-state components, fully rated for continuous duty, unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.

1. Waterproof Equipment: Listed and labeled for duty outdoors or in damp locations.

2.3 CALL-IN SWITCH

A. Mounting: Flush, unless otherwise indicated, and suitable for mounting conditions indicated

B. Switch: Single Pole momentary spring return rocker switch.

C. Faceplate: Stainless steel or anodized aluminum with tamperproof mounting screws.

D. Back Box: Single-gang galvanized steel with 2-1/2-inch minimum depth.

E. Model #: Valcom V-2972PK

2.4 ADMINISTRATION CONSOLE

A. Large eight-line backlit screen with six display keys and contrast control.

B. Call display with visual call waiting

C. Speaker phone with mute

D. Menu driven soft keys

E. 100-Name and Numbers callers list.

F. 200-Name and number directory

G. Model #: Valcom VEADP

2.5 ALL-CALL AMPLIFIER

A. Comply with EIA SE-101-A.

B. Minimum Output Power: 1 W, RMS for each station and speaker that can be connected in all-call mode of operation, plus an allowance for future stations.

C. Total Harmonic Distortion: Less than 5 percent at rated output power with a load equivalent to quantity of stations connected in all-call mode of operation.

D. Minimum Signal-to-Noise Ratio: 60 dB, at rated output.

E. Frequency Response: Within plus or minus 2 dB from 50 to 12,000 Hz.

F. Output Regulation: Maintains output level within 2 dB from full to no load.

G. Input Sensitivity: Compatible with master stations and central equipment so amplifier delivers full-rated output with a sound-pressure level of less than 10 dynes/sq. cm impinging on a master station, speaker microphone, or handset transmitter.

H. Amplifier Protection: Prevents damage from shorted or open output.

2.6 INTERCOM AMPLIFIERS

A. Comply with EIA SE-101-A.

B. Minimum Output Power: 15 W and adequate for all functions.

C. Total Harmonic Distortion: Less than 5 percent at rated output power with a load equivalent to one station connected to output terminals.

D. Minimum Signal-to-Noise Ratio: 50 dB, at rated output.

E. Frequency Response: Within plus or minus 3 dB from 70 to 10,000 Hz.

F. Output Regulation: Maintains output level within 2 dB from full to no load.

G. Input Sensitivity: Matched to input circuit and providing full-rated output with a sound-pressure level of not more than 10 dynes/sq. cm impinging on microphones in master stations, speaker microphones, and handset transmitters.

H. Amplifier Protection: Prevents damage from shorted or open output.

I. Model #: Valcom VENRK

2.7 CONE-TYPE LOUDSPEAKERS

A. Comply with EIA SE-103.

B. Minimum Axial Sensitivity: EIA pressure rating of 45 dB.

C. Frequency Response: Within plus or minus 3 dB from 70 to 17,000 Hz.

D. Power rating: 5 watts continuous

E. Minimum Dispersion Angle: 100 degrees.

F. Line Transformer: Comply with EIA-160, maximum insertion loss of 0.5 dB, power rating equal to speaker's, and at least four level taps.

G. Enclosures: Steel housings or back boxes, acoustically dampened, with front face of at least 0.0478-inch steel and whole assembly rust proofed and factory primed; suitable for surface ceiling, flush ceiling, pendant or wall mounting; and with relief of back pressure.

H. 24”X24” lay-in type with scuff resistant perforated grille and integral back box, white finish.

I. Size: 8 inches with 1-inch voice coil and minimum 5-oz ceramic magnet.

J. Model #: Valcom VECTLA-2

K. Model #: Quam System 12

2.8 HORN-TYPE LOUDSPEAKERS

A. Comply with EIA SE-101-A. All-metal, weatherproof construction.

B. Frequency Response: 275HZ to 14,000 Hz.

C. Minimum Power Rating of Driver: 15 W, continuous.

D. Minimum Dispersion Angle: 110 degrees.

E. Line Transformer: Comply with EIA-160, maximum insertion loss of 0.5 dB, power rating equal to speaker's, and at least four volume taps.

F. Atlas VT series or equal.

2.9 CONDUCTORS AND CABLES

A. Conductors: category 3/5.

B. Insulation: Thermoplastic, not less than 1/32 inch.

C. Plenum Cable: Listed and labeled for plenum use.

D. Underground cabling: Please provide water resistant/water blocking type, equal to West Penn “Aquaseal”.

2.10 EQUIPMENT FRAMES

A. General Frame Requirements:

1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Module Dimension: Width compatible with EIA 310-D standard, 19-inch panel mounting.
3. Finish: Manufacturer's standard, baked-polyester powder coat.
4. Manufacturer: APC

B. Modular Freestanding Cabinets:

1. Removable and lockable side panels.
2. Hinged and lockable front and rear doors.
3. Adjustable feet for leveling.
4. Screened ventilation openings in the roof and rear door.
5. Cable access provisions in the roof and base.
6. Grounding bus bar.
7. Power strip.
8. Baked-polyester powder coat finish.
9. All cabinets keyed alike.

C. Modular Wall Cabinets:

1. Wall mounting.
2. Aluminum construction.
3. Treated to resist corrosion.
4. Lockable front and rear doors.
5. Louvered side panels.
6. Cable access provisions top and bottom.
7. Grounding lug.
8. Power strip.
9. All cabinets keyed alike.

D. Cable Management for Equipment Frames:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.11 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Rack mounting.
3. Six 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
4. LED indicator lights for power and protection status.
5. LED indicator lights for reverse polarity and open outlet ground.
6. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
7. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
8. Cord connected with 15-foot line cord.
9. Rocker-type on-off switch, illuminated when in on position.
10. Peak Single-Impulse Surge Current Rating: 33kA per phase.
11. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all three modes shall be not more than 330 V.

12. Manufacturer: APC

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment to comply with manufacturer's written instructions.

B. Wiring Method: Install wiring in raceway (concealed inside walls, above inaccessible ceilings and below floor). When above accessible ceiling install on cable tray (if available) and or parallel and or perpendicular to surfaces or exposed structural members, and follow surface contours. Secure and support cables by straps, staples, or similar fittings so designed and installed to avoid damage to cables. Secure cable at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, or fittings. Use plenum cable in environmental air spaces, including plenum ceilings. Raceways shall comply with Division 16. Inside existing office building provide one piece metal surface raceway (below ceiling).

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess. Use lacing bars in cabinets.

D. Control-Circuit Wiring: Install number and size of conductors as recommended by system manufacturer for control functions indicated.

E. Separation of Wires: Separate speaker, microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches for speakers and adjacent parallel power and telephone wiring. Separate other school intercom and program equipment conductors as recommended by equipment manufacturer.

F. Splices, Taps, and Terminations: Make splices, taps, and terminations on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

G. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.

H. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables to identify media in coordination with system wiring diagrams.

3.2 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.

C. Install grounding electrodes as specified in Division 16 Section "Grounding."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installations, including connections. Report results in writing.

B. Programming: Fully brief Owner on available programming options. Record Owners decisions and set up initial system program. Prepare a written record of decisions, implementation methodology, and final results.

C. Operational Test: Test originating station-to-station, all-call, and page messages at each intercom station. Verify proper routing and volume levels and freedom from noise and distortion. Test each available message path from each station on system.

D. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use a sound-level meter with octave-band filters to measure level at five locations in each paging zone. Maximum permissible variation in level is plus or minus 3 dB, and in levels between adjacent zones are plus or minus 5 dB.

E. Power Output Test: Measure electrical power output of each paging amplifier at normal gain setting at 150, 1000, and 2500 Hz. Maximum variation in power output at these frequencies is plus or minus 3 dB.

F. Retesting: Correct deficiencies and retest. Prepare written record of tests.

G. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging and independent room speaker-line matching transformers.

H. Schedule tests with at least seven days advance notice of test performance.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment as specified below:

1. Train Owners maintenance personnel on programming equipment for starting up and shutting down, troubleshooting, servicing, and maintaining equipment.
2. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
3. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
4. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 267230

SECTION 267240 - INTRUSION DETECTION

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. This document is intended to specify the requirements for the provision of all equipment, materials, labor, documentation and services necessary to furnish and install a complete and operational integrated security access control and alarm monitoring (ACAM) system. The system shall consist of a fully automated and integrated computer-based security system, including, but not limited to the following functions and capabilities:
   a. Security alarm monitoring and reporting of alarm and trouble conditions detected by sensors and/or devices in local and remote locations
   b. Control panel shall be expandable or networked to connect the future buildings.

1.3 DEFINITIONS

A. LCD: Liquid-crystal display.

B. LED: Light-emitting diode.

C. PIR: Passive infrared.

D. RFI: Radio-frequency interference.

E. UPS: Uninterruptible power supply.

F. Protected or Protection Zone: A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any interface equipment between sensors and communication link to central-station control unit.

1.4 SUBMITTALS

A. Product Data: Components for sensing, detecting**,** and control, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.

1. Functional Block Diagram: Show single-line interconnections between components including interconnections between components specified in this Section and those furnished under other Sections. Indicate control, signal, and data communication paths. \
2. Raceway Riser Diagrams: Detail raceway runs required for intrusion detection and for systems integration. Include designation of devices connected by raceway, raceway type, and size, and type and size of wire and cable fill for each raceway run.
3. Device Address List: Coordinate with final system programming.
4. System Wiring Diagrams: Include system diagrams unique to Project. Show connections for all devices, components, and auxiliary equipment. Include diagrams for equipment and for system with all terminals and interconnections identified.
5. Details of surge-protection devices and their installation.
6. Sensor detection patterns and adjustment ranges.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For intrusion detection system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Data for each type of product, including features and operating sequences, both automatic and manual.

E. Warranty: Special warranty specified in this Section.

F. Other Information Submittals:

1. Test Plan and Schedule: Test plan defining all tests required to ensure that system meets technical, operational, and performance specifications.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:
1. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Intrusion Detection Systems Integrator Qualifications: An experienced intrusion detection equipment supplier who has completed systems integration work for installations 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.

C. FMG Compliance: FMG-approved and -labeled intrusion detection devices and equipment.

D. Comply with NFPA 70.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace (labor and materials) components of intrusion detection devices and equipment that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

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. Intrusion Detection Devices: Furnish quantity equal to two percent of the number of units of each type installed, but no less than one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

A. Supervision: System components shall be continuously monitored for normal, alarm, supervisory**,** and trouble conditions. Indicate deviations from normal conditions at any location in system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.

1. Alarm Signal: Display at central-station control unit and actuate audible and visual alarm devices.
2. Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate system problems such as battery failure, open or shorted transmission line conductors, or controller failure.
3. Supervisory Condition Signal: Distinct from other signals, indicating an abnormal condition as specified for the particular device or controller.

B. System Control: Central-station control unit shall directly monitor intrusion detection units and connecting wiring.

C. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance.

D. Operator Commands:
1. Acknowledge Alarm: To indicate that alarm message has been observed by operator.
2. Place Protected Zone in Access: Disable all intrusion-alarm circuits of a specific protected zone. Tamper circuits may not be disabled by operator.
3. Place Protected Zone in Secure: Activate all intrusion-alarm circuits of a protected zone.
4. Protected Zone Test: Initiate operational test of a specific protected zone.
5. System Test: Initiate system-wide operational test.

E. Circuit Supervision: Supervise all signal and data transmission lines, links with other systems, and sensors from central-station control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an

LED. Maximum permissible elapsed time between occurrence of a trouble condition and indication at central-station control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.

F. Programmed Secure-Access Control: System shall be programmable to automatically change status of various combinations of protected zones between secure and access conditions at scheduled times. Status changes may be preset for repetitive, daily, and weekly; specially scheduled operations may be preset up to a year in advance. Manual secure-access control stations shall override programmed settings.

2.3 SYSTEM COMPONENT REQUIREMENTS

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.

1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Division 16 Section "Transient Voltage Suppression."
2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Comply with requirements in Division 16 Section "Transient Voltage Suppression" as recommended by manufacturer for type of line being protected.

B. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V RMS injected into power supply lines at 10 to 10,000 MHz.

C. Tamper Protection: Tamper switches on detection devices, controllers, annunciators, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled and when entering conductors are cut or disconnected.

D. Manufacturers:

1. Bosch
2. Napco

E. Keypad and Display Module:
1. Arranged for entering and executing commands for system-status changes and for displaying system-status and command-related data.
2. 13 Character Alpha Numeric display.
3. Furnish with STI6560 protective cover with keyed lock.

F. Cellular Communicator:
1. Provide and install Napco Starlink NAP-SLEGSM34GFREE cellular communicator and provide monitoring for 1 year. Automatically transmit alarm, trouble, and supervisory signals to a remote alarm station through this cellular communicator.

2.4 DOOR AND WINDOW SWITCHES

A. Description: Balanced-magnetic switch, complying with UL 634, installed on frame with integral overcurrent device to limit current to 80 percent of switch capacity. Bias magnet and minimum of two encapsulated reed switches shall resist compromise from introduction of foreign magnetic fields.

B. Flush-Mounted Switches: Unobtrusive and flush with surface of door and window frame.

C. Overhead Door Switch: Balanced-magnetic type, listed for outdoor locations, and having door-mounting magnet and floor-mounting switch unit.

2.5 MICROWAVE-PIR DUAL-TECHNOLOGY MOTION SENSORS

A. Description: Single unit combining a sensor that detects changes in microwave signals and a PIR sensor that detects changes in ambient level of infrared emissions caused by standard-intruder movement within detection pattern.

B. Device Performance: An alarm is transmitted when either sensor detects a standard intruder within a period of three to eight seconds from when the other sensor detects a standard intruder.

1. Minimum Detection Pattern: A room 20 by 30 feet.
2. PIR Sensor Sensitivity: Adjustable pattern coverage to detect a change in temperature of 2 deg F or less, and standard-intruder movement within sensor's detection patterns at any speed between 0.3 to 7.5 fps across 2 adjacent segments of detector's field of view.
3. Microwave Sensor Sensitivity: Adjustable, able to detect standard-intruder movement within sensor's detection pattern at any speed between 0.3 to 7.5 fps. Sensor sensitivity adjustments shall be accessible only when sensor housing is removed, and sensors shall comply with 47 CFR 15.
4. Activation Indicator: LED indicator shall not be visible during normal operation. Indicator shall light when sensor detects a standard intruder. Locate test enabling switch under sensor housing cover.

2.6 ACOUSTIC-TYPE, GLASS-BREAK SENSORS:

A. Detect unique, airborne acoustic energy spectrum caused by breaking glass.

1. Sensor Element: Microprocessor-based, digital device to detect breakage of plate, laminate, tempered, and wired glass while rejecting common causes of false alarms. Detection pattern shall be at least a 20-foot range.
2. Hookup Cable: Factory installed, not less than 72 inches.
3. Activation Indicator: LED on sensor housing that lights when responding to vibrations, remaining on until manually reset at sensor controller or at central-station control unit.
4. Controller: Integral with sensor housing or in a separate assembly, locally adjustable by control under housing cover.

2.7 AUDIBLE AND VISUAL ALARM DEVICES

A. Siren: 30-W speaker with siren driver, rated to produce a minimum sound output of 103 dB at 10 feet from central-station control unit.

1. Enclosure: Weather-resistant steel box with tamper switches on cover and on back of box.

B. Strobe: Xenon light complying with UL 1638, with a clear polycarbonate lens.

1. Light Output: 115 cd, minimum.
2. Flash Rate: 60 per minute.

PART 3 - EXECUTION

3.1 SYSTEM INSTALLATION

A. Comply with UL 681.

3.2 WIRING INSTALLATION

A. Installation: UL 681.

B. Wiring Method: Install wiring in raceways except in accessible indoor ceiling spaces. Secure from building structure steel (no from walls) by means of J-hooks. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be 1/2 inch. Control and data transmission wiring shall not share conduit with other building wiring systems.

C. Where available lay out cables in cable tray.

D. Wiring shall not be exposed below ceiling.

E. Raceway system shall comply with Section 16130.

F. Each security device is to have an individual cable from the device to the Control Panel.

G. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

H. Wires and Cables:

1. Conductors: Size as recommended in writing by system manufacturer, unless otherwise indicated.

2. 120-V Power Wiring: Install according to Division 16 Section "Conductors and Cables," unless otherwise indicated.
3. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable, unless otherwise indicated or if manufacturer recommends shielded cable.
4. Provide rated for return open plenum.
5. Underground cabling: Please provide water resistant/water blocking type, equal to West Penn “Aquaseal”.

I. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

J. Install power supplies and other auxiliary components for detection devices at controllers, unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.

K. Identify components with engraved, laminated-plastic or metal nameplate for central-station control unit and each terminal cabinet, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 16 Section "Electrical Identification."

3.3 ZONES

A. Each building area shall be zoned by occupancy areas (office area, kitchen, science lab, computer lab, first floor classrooms, second floor classrooms) and interior and exterior zones

3.4 GROUNDING

A. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding. Provide 5-ohm ground. Measure, record, and report ground resistance.

C. Install grounding electrodes of type, size, location, and quantity indicated. Comply with installation requirements in Division 16 Section "Grounding and Bonding."

3.5 FIELD QUALITY CONTROL

A. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with requirements in the Contract Documents. Correct deficiencies observed in pretesting.

1. Report of Pretesting: After pretesting is complete, provide a letter certifying that installation is complete and fully operable; include names and titles of witnesses to preliminary tests.

B. Perform the following field tests and inspections and prepare reports:

1. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
2. Operational Tests: Schedule tests after pretesting has been successfully completed. Test all modes of system operation and intrusion detection at each detection device. Test for detection of intrusion and for false alarms in each protected zone. Test for false alarms by simulating activities outside indicated detection patterns.

C. Report of Tests and Inspections: Prepare a written record of tests, inspections, and detailed test results in the form of a test log.

D. Tag all equipment, stations, and other components for which tests have been satisfactorily completed.

3.6 MONITORING

A. Include in bid proposal the cost for 1 year remote monitoring. Monitoring station shall UL listed and 24 hour 365 days operation.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain intrusion detection. Refer to Division 1 Section "Demonstration and Training."

B. Train Owners maintenance personnel on programming equipment for starting up and shutting down, troubleshooting, servicing, and maintaining equipment. Provide a minimum of two 2 hours training.

3.8 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

END OF SECTION 267240

PART I - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes a system for amplifying sound signals from sources such as microphones and distributing and reproducing them on loudspeakers at various locations. Provide cabling to interface with multimedia outlet.

1.03 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of products specified.

C. Shop Drawings detailing public address and music systems including, but not limited to, the following:

1. System block diagrams.
2. Control panels.

D. Wiring diagrams detailing wiring for power, signal, and control systems and differentiating clearly between manufacturer installed and field-installed wiring. Identify terminals to facilitate installation, operation, and maintenance.

E. Report of field tests and observations, including record of final tap settings of speaker line matching transformers and signal ground-resistance measurement certified by Installer.

F. Maintenance data for system to include in the operation and maintenance manual specified in Division 1.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who is an authorized representative of the system manufacturer to perform Work of this Section.

B. Manufacturer Qualifications: Engage a firm experienced in manufacturing professional sound reinforcement systems complying with the requirements of these Specifications and experienced with at least 5 projects of similar size and scope that have been in operation for 3 years or more.

C. Listing Labeling: Provide products specified in this Section that are listed and labeled.

1. This Terms "listed and Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing

Laboratory" (NTRL) as defined in OSHA Regulation 1910.7.

D. Comply with NFPA 70.

E. Comply with UL50.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one the following:

1. Altec Corp.
2. Atlas-Soundolier
3. Dukane Corp.
4. Electro-Voice, Inc.
5. TOA Electronics, Inc.
6. Biamp Systems

2.02 SYSTEM REQUIREMENTS

A. Coordinate the features of materials and equipments to form an integrated system. Match components and interconnections for optimum performance of specified functions.

B. Functional Performance: System functions include, but are not limited to the following:

1. Selectability of sources for amplifying sound between various microphone outlets and other inputs.
2. High-Quality Sound Reproduction: Sound is free from noises, such as pops, clicks hisses, and hums at all loudspeakers at all times during system operation including standby mode with inputs off. System output is free from distortion and nonuniform coverage of amplified sound.

2.03 EQUIPMENT

A. General: Use all solid-state components, fully rated for continuous duty at the ratings indicated. Select equipment for normal operation on input power usually supplied at 105 to 130 V, 60 Hz.

B. In Wall Amplifier: Comply with EIA-SE-101. Provide with the following features:

1. Five balanced microphone line level mixer input channels.
2. One stereo summing line level input channel.
3. High & low equalization on each mixer input channel.
4. Independent main & zone level controls on each channel.
5. Main and zone mixed outputs with master level controls.
6. 9-band graphic equalization for amplified outputs.
7. Patch point between mixer outputs and equalizer inputs.
8. 120W amplification
9. 24 Volt phantom power selectable for microphone inputs, optional remote control

10. "In-wall" chassis with security cover.
11. Five Year Warranty
12. UL Listed.
13. Frequency response shall be +0/-3db from 60Hz to 20KHZ at rated power.
14. Total harmonic distortion shall be less than 0.5% from 80 Hz to 20 KHz at rated
15. Signal-to-noise shall be greater than 90dB from 20 Hz to 20KH2 at rated power.
6. Mixer outputs (Main & Zone):
    a) Maximum output level +21 dBU (8.7V)
    b) Output Impedance <50 OHMS
17. Gain:
    a) Mic input to main/zone output 66dB
    b) Line Input to main/zone output 10 dB
    c) Equalizer input to amplifier output 26dB

C. Central Speaker. Shall be or equal to KDM Electronics Inc. Model No. SP840A. Provide with following features:

1.	Frequency Response:	30Hz to 20 kHz +/- 10 dB (on axis) 40 Hz to 12 kHz +/- 6 dB (on axis)
2.	Optimum Power:	50 to 250 watts RMS total
3.	Power Handling:	300 watts RMS total, 600 watts peak, (Total Harmonic Distortion less than 10%)
4.	Impedance;	8 ohms nominal.
5.	Dispersion:	360 deg. Horizontal, 180 deg. Vertical +/- 6 dB Level 100 Hz to 10 kHz
6.	Sensitivity:	104 dB/watt/meter on axis, pink noise 100 Hz to 10 kHz
7.	Maximum S.P.L.:	128 dB RMS/131 dB Peak at 1 meter
8.	Size	16" height

D. Microphone: Comply with EIA-SE-105. Provide microphone with features as follows:
1. Impedance: 95 OHMS at 100 Hz.
2. Frequency response: 70-20 KHz
3. Microphone outlets shall be:
    a. Conquest CP1DF wall mounted
    b. Mystery FMA 1100 floor mounted with one Microphone input (XLR).
4. Provide the following accessories:
    a. Two each Altec 658.
    b. Two each Atlas Soundolier MS-12C Stand.
    c. Two 25 ft. Microphone cable.
5. Speaker cable shall be 2 cond. #18 ga. Microphone cable shall be 1 pr. #22 ga. Any cable installed in the return Air Plenum shall be in conduit.

E. ASSISTIVE LISTENING SYSTEM
1. Furnish and install an FM wireless assistive listening system for use by the hearing impaired.
2. Locate antennas above attached to bar joists.
3. Furnish and install the following.
    a. Telex AAT-2 or approved equal transmitter with 15K ohm: 15K ohm bridging
    b. Telex AAR-10 receiver with battery (Qty: 50 ea.)
    c. Telex DEB-1 double earbud. (Qty: 50 ea.)

F. WIRING AND CABLE: Jacketed, twisted-pair, #18 AWG, stranded copper conductors.
   1. Insulation for wire in conduit: Thermoplastic, not less than 1/32 inch (0.8 mm)
   2. Microphone Cables: Neoprene jacketed, not less than 2/64 inch (0.8 mm) thick over shield with filled interstices. Shield No. 34 AWG tinned, soft-copper strands formed into a braid or approved equivalent foil. Shielding coverage on the conductors not less than 60 percent.

D. GROUNDING COMPONENTS: As specified in Division 16 Section "Grounding."

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install equipment to comply with manufacturer's written instructions.

B. Wiring Method: Install wiring in raceway except within consoles, desks, and counters. Conceal raceway and wiring except in unfinished spaces.

C. Wiring Method: Install wiring in raceway except within consoles, desks, and counters and except in accessible ceiling spaces and in gypsum-board partitions where cable wiring method may be used. Use plenum cable in environmental air spaces, including plenum ceilings. Conceal cable and raceway wiring except in unfinished spaces.

D. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours. Secure and support cables by straps, staples, or similar fittings so designed and installed as not to damage the cables. Secure cable at intervals not exceeding 30 inches (762 mm) and not more than 6 inches (152 mm) from cabinets, boxes, or fittings.

E. Wiring within Enclosures: Provide adequate length of conductors. Bundle, lace, and train the conductors to terminal points with no excess. Provide and use lacing bars.

F. Control Circuit Wiring: Provide number of conductors as recommended by system manufacturer for control functions indicated.

G. Splices, Taps and Terminations: Make splices, taps and terminations on numbered terminal strips in junction, pull and outlet boxes, terminal cabinets, and equipment enclosures.

H. Impedance and Level Matching: Carefully match input and output impedances and signal level at audio signal interfaces. Provide matching networks where required.

I. Provide physical isolation from each other for microphone, line-level, speaker, and power wiring. Run in separate raceways or provide 12-inch (305-mm) minimum separation where exposed or in same enclosure. Provide additional physical separation as recommended by equipment manufacturer.

J. Microphone Outlets: Install as follows, except as otherwise indicated.

   1. Wall Outlets: Flush mounted

2. Floor outlets: Provide 10" X 12" X 6" steel box. Floor outlet shall be provided with a lift of section and hinged trap door to accommodate cable exit. Cover shall be 1/8" thick with 1/4" brass edging. Trim with carpet in carpeted areas.

N. Conductor Sizing: Except as otherwise indicated size speaker circuit conductors from racks to loudspeaker outlets not smaller than No. 18 AWG and conductors from microphone receptacles to amplifiers not smaller than No. 22 AWG.

L. Identification of Conductors and Cables: Use color coding of conductors and apply wire and cable marking tape to designate wires and cables so all media are identified in coordination with system wiring diagrams.

M. Line Matching Transformer Connections: Make initial connections using tap settings indicated on the Drawings.

N. Multimedia equipment: interface projector and multimedia outlet with amplifier and central speaker.

3.02 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding.

C. Install grounding electrodes of type, size, location, and quantity as indicated. Comply with installation requirements of Division 16 Section "Grounding."

3.03 Field Quality Control

A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the testing and adjustment of the system.

B. Testing Procedure: Conform to the following:

1. Schedule tests a minimum of 7 days in advance of performance.
2. Report: Submit a written record of test results.
3. Operational Test: Perform operational system test to verify conformance of system to these Specifications. Perform tests that include originating program and page material at microphone outlets, preamplifier program inputs, and other inputs. Verify proper volume levels and freedom from noise and distortion.
4. Signal to Noise Ratio Test: Measure the ratio of signal to noise of the complete system at normal gain settings, using the following procedure:
   Disconnect a microphone at the connector or jack closest to it and replace it the circuit with a signal generator using a 1000-Hz signal. Replace all other microphones at the corresponding connectors with dummy loads, each in impedance to the microphone it replaces. Measure the ratio of signal to noise.

5. Acoustic Coverage Test: Feed pink noise into the system using octaves centered at 500 and 4000 Hz. Use a sound-level meter with octave band filters to measure the level at 5 locations in each zone. For spaces with seated audiences, the maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in the same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.

C. Inspection: Verify that units and controls are properly labeled, and interconnecting wires and terminals are identified.

D. Retesting: Rectify deficiencies indicated by tests and observations. Include revising tap settings of speaker line matching transformers where necessary to optimize volume and uniformity of sound levels. Completely retest work affected by such deficiencies at the Contractor's expense. Verify by the system tests that the total system meets the specifications and complies with applicable standards. Provide a written record of all retest results.

3.04 CLEANING

A. Prior to final acceptance, clean system components and protect from damage and deterioration.

3.05 DEMONSTRATION

A. Demonstration and Training: Obtain and pay for the services of a factory-authorized service representative to demonstrate the system in all operating modes and functions and to train Owner's maintenance personnel.

B. Schedule training with Owner with at least 7 days' advance notice.

C. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance. Provide a minimum of 3 hours' training.

D. Training Aid use the approved operation and maintenance manual as an instructional aid. Refer to Division 1 Section "Contract Closeout." Provide copies of pertinent excerpts from the manual for use in the instruction.

END OF SECTION 267260

PART I - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes a system for amplifying sound signals from sources such as microphones and distributing and reproducing them on loudspeakers at various locations. Provide cabling to interface with multimedia outlet.

1.03 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of products specified.

C. Shop Drawings detailing public address and music systems including, but not limited to, the following:

1. System block diagrams.
2. Control panels.

D. Wiring diagrams detailing wiring for power, signal, and control systems and differentiating clearly between manufacturer installed and field-installed wiring. Identify terminals to facilitate installation, operation, and maintenance.

E. Report of field tests and observations, including record of final tap settings of speaker line matching transformers and signal ground-resistance measurement certified by Installer.

F. Maintenance data for system to include in the operation and maintenance manual specified in Division 1.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who is an authorized representative of the system manufacturer to perform Work of this Section.

B. Manufacturer Qualifications: Engage a firm experienced in manufacturing professional sound reinforcement systems complying with the requirements of these Specifications and experienced with at least 5 projects of similar size and scope that have been in operation for 3 years or more.

C. Listing Labeling: Provide products specified in this Section that are listed and labeled.

1. This Terms "listed and Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing

Laboratory" (NTRL) as defined in OSHA Regulation 1910.7.

D. Comply with NFPA 70.

E. Comply with UL50.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one the following:

1. Altec Corp.
2. Atlas-Soundolier
3. Dukane Corp.
4. Electro-Voice, Inc.
5. TOA Electronics, Inc.
6. Biamp Systems

2.02 SYSTEM REQUIREMENTS

A. Coordinate the features of materials and equipments to form an integrated system. Match components and interconnections for optimum performance of specified functions.

B. Functional Performance: System functions include, but are not limited to the following:
1. Selectability of sources for amplifying sound between various microphone outlets and other inputs.
2. High-Quality Sound Reproduction: Sound is free from noises, such as pops, clicks hisses, and hums at all loudspeakers at all times during system operation including standby mode with inputs off. System output is free from distortion and nonuniform coverage of amplified sound.

2.03 EQUIPMENT

A. General: Use all solid-state components, fully rated for continuous duty at the ratings indicated. Select equipment for normal operation on input power usually supplied at 105 to 130 V, 60 Hz.

B. In Wall Amplifier: Comply with EIA-SE-101. Provide with the following features:

1. Five balanced microphone line level mixer input channels.
2. One stereo summing line level input channel.
3. High & low equalization on each mixer input channel.
4. Independent main & zone level controls on each channel.
5. Main and zone mixed outputs with master level controls.
6. 9-band graphic equalization for amplified outputs.
7. Patch point between mixer outputs and equalizer inputs.
8. 120W amplification
9. 24 Volt phantom power selectable for microphone inputs, optional remote control
10. "In-wall" chassis with security cover.

11. Five Year Warranty
12. UL Listed.
13. Frequency response shall be +0/-3db from 60Hz to 20KHZ at rated power.
14. Total harmonic distortion shall be less than 0.5% from 80 Hz to 20 KHz at rated
15. Signal-to-noise shall be greater than 90dB from 20 Hz to 20KH2 at rated power.
16. Mixer outputs (Main & Zone):
    a) Maximum output level +21 dBU (8.7V)
    b) Output Impedance <50 OHMS
17. Gain:
    a) Mic input to main/zone output 66dB
    b) Line Input to main/zone output 10 dB
    c) Equalizer input to amplifier output 26dB

C. Cafeteria Speaker. Shall be or equal to JBL Model 65P/T
Provide with following features:

1.	Frequency Response:	55Hz to 20 kHz
2.	Frequency Range:	78 Hz to 18 kHz
3.	Power capacity:	75 continuous Pink Noise Power (with 300 Watts Peak) 150 Watts Continuous Program Power.
4.	Impedance;	8 ohms nominal.
5.	Nominal coverage:	120 degrees
6.	Nominal Sensitivity:	86 dB
7.	Directivity:	5.3
8.	Rated Maximum SPL @ 1m:	105dB continuous pink noise, 111dB
8.	Size	9.3” X 10.2” X 11”

D. Microphone: Comply with EIA-SE-105. Provide microphone with features as follows:

1. Impedance: 95 OHMS at 100 Hz.
2. Frequency response: 70-20 KHz
3. Microphone outlets shall be:
    a. Conquest CP1DF wall mounted
    b. Mystery FMA 1100 floor mounted with one Microphone input (XLR).
4. Provide the following accessories:
    a. Two each Altec 658.
    b. Two each Atlas Soundolier MS-12C Stand.
    c. Two 25 ft. Microphone cable.
5. Speaker cable shall be 2 cond. #18 ga. Microphone cable shall be 1 pr. #22 ga. Any cable installed in the return Air Plenum shall be in conduit.

E. ASSISTIVE LISTENING SYSTEM

1. Furnish and install an FM wireless assistive listening system for use by the hearing impaired.
2. Locate antennas above attached to bar joists.
3. Furnish and install the following.
    a. Telex AAT-2 or approved equal transmitter with 15K ohm: 15K ohm bridging
    b. Telex AAR-10 receiver with battery (Qty: 50 ea.)
    c. Telex DEB-1 double earbud. (Qty: 50 ea.)

F. WIRING AND CABLE: Jacketed, twisted-pair, #18 AWG, stranded copper conductors.

1. Insulation for wire in conduit: Thermoplastic, not less than 1/32 inch (0.8 mm)
2. Microphone Cables: Neoprene jacketed, not less than 2/64 inch (0.8 mm) thick over shield with filled interstices. Shield No. 34 AWG tinned, soft-copper strands formed into a braid or approved equivalent foil. Shielding coverage on the conductors not less than 60 percent.

D. GROUNDING COMPONENTS: As specified in Division 16 Section "Grounding."

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install equipment to comply with manufacturer's written instructions.

B. Wiring Method: Install wiring in raceway except within consoles, desks, and counters. Conceal raceway and wiring except in unfinished spaces.

C. Wiring Method: Install wiring in raceway except within consoles, desks, and counters and except in accessible ceiling spaces and in gypsum-board partitions where cable wiring method may be used. Use plenum cable in environmental air spaces, including plenum ceilings. Conceal cable and raceway wiring except in unfinished spaces.

D. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours. Secure and support cables by straps, staples, or similar fittings so designed and installed as not to damage the cables. Secure cable at intervals not exceeding 30 inches (762 mm) and not more than 6 inches (152 mm) from cabinets, boxes, or fittings.

E. Wiring within Enclosures: Provide adequate length of conductors. Bundle, lace, and train the conductors to terminal points with no excess. Provide and use lacing bars.

F. Control Circuit Wiring: Provide number of conductors as recommended by system manufacturer for control functions indicated.

G. Splices, Taps and Terminations: Make splices, taps and terminations on numbered terminal strips in junction, pull and outlet boxes, terminal cabinets, and equipment enclosures.

H. Impedance and Level Matching: Carefully match input and output impedances and signal level at audio signal interfaces. Provide matching networks where required.

I. Provide physical isolation from each other for microphone, line-level, speaker, and power wiring. Run in separate raceways or provide 12-inch (305-mm) minimum separation where exposed or in same enclosure. Provide additional physical separation as recommended by equipment manufacturer.

J. Microphone Outlets: Install as follows, except as otherwise indicated.

1. Wall Outlets: Flush mounted
2. Floor outlets: Provide 10" X 12" X 6" steel box. Floor outlet shall be provided with a lift of section and hinged trap door to accommodate cable exit. Cover shall be 1/8" thick with 1/4" brass edging. Trim with carpet in carpeted areas.

N. Conductor Sizing: Except as otherwise indicated size speaker circuit conductors from racks to loudspeaker outlets not smaller than No. 18 AWG and conductors from microphone receptacles to amplifiers not smaller than No. 22 AWG.

L. Identification of Conductors and Cables: Use color coding of conductors and apply wire and cable marking tape to designate wires and cables so all media are identified in coordination with system wiring diagrams.

M. Line Matching Transformer Connections: Make initial connections using tap settings indicated on the Drawings.

N. Multimedia equipment: interface projector and multimedia outlet with amplifier and central speaker.

3.02 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding.

C. Install grounding electrodes of type, size, location, and quantity as indicated. Comply with installation requirements of Division 16 Section "Grounding."

3.03 Field Quality Control

A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the testing and adjustment of the system.

B. Testing Procedure: Conform to the following:

1. Schedule tests a minimum of 7 days in advance of performance.
2. Report: Submit a written record of test results.
3. Operational Test: Perform operational system test to verify conformance of system to these Specifications. Perform tests that include originating program and page material at microphone outlets, preamplifier program inputs, and other inputs. Verify proper volume levels and freedom from noise and distortion.
4. Signal to Noise Ratio Test: Measure the ratio of signal to noise of the complete system at normal gain settings, using the following procedure:

   Disconnect a microphone at the connector or jack closest to it and replace it the circuit with a signal generator using a 1000-Hz signal. Replace all other

microphones at the corresponding connectors with dummy loads, each in impedance to the microphone it replaces. Measure the ratio of signal to noise.

5. Acoustic Coverage Test: Feed pink noise into the system using octaves centered at 500 and 4000 Hz. Use a sound-level meter with octave band filters to measure the level at 5 locations in each zone. For spaces with seated audiences, the maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in the same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.

C. Inspection: Verify that units and controls are properly labeled, and interconnecting wires and terminals are identified.

D. Retesting: Rectify deficiencies indicated by tests and observations. Include revising tap settings of speaker line matching transformers where necessary to optimize volume and uniformity of sound levels. Completely retest work affected by such deficiencies at the Contractor's expense. Verify by the system tests that the total system meets the specifications and complies with applicable standards. Provide a written record of all retest results.

3.04 CLEANING

A. Prior to final acceptance, clean system components and protect from damage and deterioration.

3.05 DEMONSTRATION

A. Demonstration and Training: Obtain and pay for the services of a factory-authorized service representative to demonstrate the system in all operating modes and functions and to train Owner's maintenance personnel.

B. Schedule training with Owner with at least 7 days' advance notice.

C. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance. Provide a minimum of 3 hours' training.

D. Training Aid use the approved operation and maintenance manual as an instructional aid. Refer to Division 1 Section "Contract Closeout." Provide copies of pertinent excerpts from the manual for use in the instruction.

END OF SECTION 267260

SECTION 268050 - HAND DRYERS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnishing and installation of electric hand dyers.

1.2 RELATED SECTIONS

B. Basic Electrical Requirements - Section 260100

C. Wire and Cables - Section 260519

D. Grounding and Bonding- Section 260526

E. Raceways and Boxes - Section 260533

1.3 SUBMITTALS

A. First two paragraphs below are defined in Division 01 Section "Submittal Procedures" as "action submittals."

1.4 WARRANTY

A. Provide a 5-year minimum warranty from date of acceptance of project.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Excel Dryer, Inc.

2.2 MINIMUM FEATURES

B. Hand dryer cover shall be a one-piece, heavy-duty, rib-reinforced, die-cast zinc alloy. It shall be lightweight, unbreakable, rustproof and all exposed surfaces shall be bright chrome plated or finished with chip-proof, electrostatically applied epoxy paint and fastened to a wall plate by two chrome plated tamper-proof bolts.

C. Hand dryer wall plate shall be equipped with (3) 7/8" diameter holes, one of which shall be suitable for use with surface conduit, for ease of wiring.
All internal hand dryer parts shall be coated according to Underwriters' Laboratories, Inc. requirements.

D. Entire mechanism shall be internally grounded.

E. Hand dryer motor shall be a series commutated through-flow discharge vacuum motor/blower (5/8 HP / 20,000 RPM) which provides air velocity of 16,000 LFM (linear feet per minute) at the air outlet and 14,000 LFM at the hands (4 inches below air outlet).

F. Hand dryer heating element (900 W) is constructed of Nichrome wire and mounted inside the blower housing, thereby being vandal proof. It shall be protected by an automatic resetting thermostat, which shall open whenever air flow is cut off and shall close when flow of air is resumed. It shall produce an air temperature of up to 135°F (57°C) at a 72°F (22°C) ambient room temperature at the hands (4 inches [102 mm] below air outlet).

G. Hand dryer Control assembly is activated by an infrared optical sensor located next to the air outlet. The dryer shall operate as long as hands are under the air outlet. There is a 35-second lockout feature if hands are not removed.

2.3 OPERATION

A. Touch-free infra-red operation activation.

B. Hand dry time measurement: 12 seconds.

C. Operation lock out period: 30 seconds.

D. Operation airflow: up to 7.39 gal/sec.

E. Rated operating noise power: 84dB(A)

2.3 ELECTRICAL

A. Voltage: 115 volts, do not use shared neutral.

B. Power Consumption: 12.5 AMPS. Entire unit shall be internally grounded.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's recommendations and instructions.

END OF SECTION 268050